Rexroth
Bosch Group

Marex SB

Manual / Marine

Version 2.10
15.07.2003

Short Instructions

Please do also see the general advice in chapter 1.

Step	Description
1	Select engine type (chapter 2 "overview")
Assembly	
2	Adjust SYSCON switch board in accordance with engine type (chapter 2 "overview")
3	- Wire components and adjust switches - Power supply (chapter 3.1) - Control head (chapter 3.2) Attention: Enter the control head ID and write it down. - Throttle and gear control ("mechanical" chapter 3.3, "electrical" chapter 3.4) - Extra functions if necessary (alarm, engine start interlock, idle speed relay, chapter 3.5 ff.)
Commissioning	
4	Enter control heads (chapter 4.2) Enter additional functions of control heads if applicable.
5	For mechanical throttle control: enter nominal value for idle speed (chapter 4.3)
6	For mechanical gear shifting: adjust position ahead / astern (chapter 4.4)
7	Enter extra functions if necessary (power boost, increased idle speed, see chapter 4.3, synchronization, buzzer in neutral, change of control station, see chapter 4.2).
Mooring Trial	
8	Adjustment of delay times for gear shifting (chapter 4.4) Adjustment of power boost if applicable (chapter 4.3) Adjustment of increased idle speed if applicable (chapter 4.3)
Sea Trial	
9	Adjustment of reversing delay times (chapter 4.4)

How to operate the system is described in chapter 5.
In case of malfunction, an error analysis as explained in chapter 6 has to be carried out.

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The diagrams and drawings used in this manual are for guidelines only and are not be used for the actual design.
This edition supersedes all previous ones.
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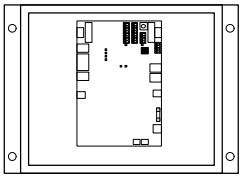
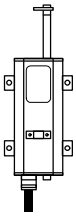
1 General

1.1 System components

Designation	Code No.	Photo	Symbol
Control head (single engine)	362 241 100 0		
Control head (twin engine)	362 241 000 0		
Control unit	346 068 000 0		
DC actuator	323 698 020 0		
I/O-extension board	346 068 721 2		
Synchro-board	346 068 730 2		
Push-/Pull-cable 2m	323 699 415 2		
Mounting kit	323 699 006 2		

Additionally required:

Data cable	LIYCY	4 x 1mm²	
Supply cable	Ölflex 100	2 x 2,5mm²	
Throttle cable	LIYCY	2 x 0,75mm²	for electrical throttle control only
Gearing cable	LIYCY	7 x 1mm²	for electrical gear shifting only
Cable alarm	LIYCY	2 x 0,75mm²	if alarm system is connected
Cable start interlock	LIYCY	2 x 0,75mm²	if engine start interlock is connected
Cable idle gas	LIYCY	2 x 0,75mm²	if idle gas is connected

1.2 General preconditions for the operation
(According to classification rules)

Indication of the current cruising command*
The current cruising command (speed, gearing position) must be indicated on every control station.

Indication of active control station*
It must be indicated on every control station which control station is in command.

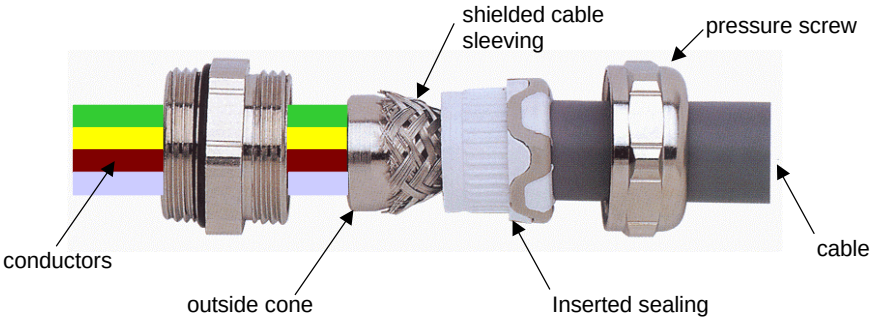
If, from any control station, any other station is visible, the indication of current cruising command and active control station is not necessary (e. g. on small yachts).

Capacity of independent actuation*
Besides the remote control, a second possibility of controlling speed and gearing must be provided.

Emergency stop-button*
A separate emergency stop-button for the engine must be installed on every control station independent from the remote control.

*These components are not included in the MAREX SB delivery.

1.3 Mounting advice
Cables to be connected to the control unit must always be provided with the metallic cable joints supplied. The joints are mounted as shown below:



Mounting work must be done only if the system is in voltage-free condition. The power supply must be secured against activation in this case.

Mounting and commissioning work must be carried out by skilled personnel and in accordance with the manual only.

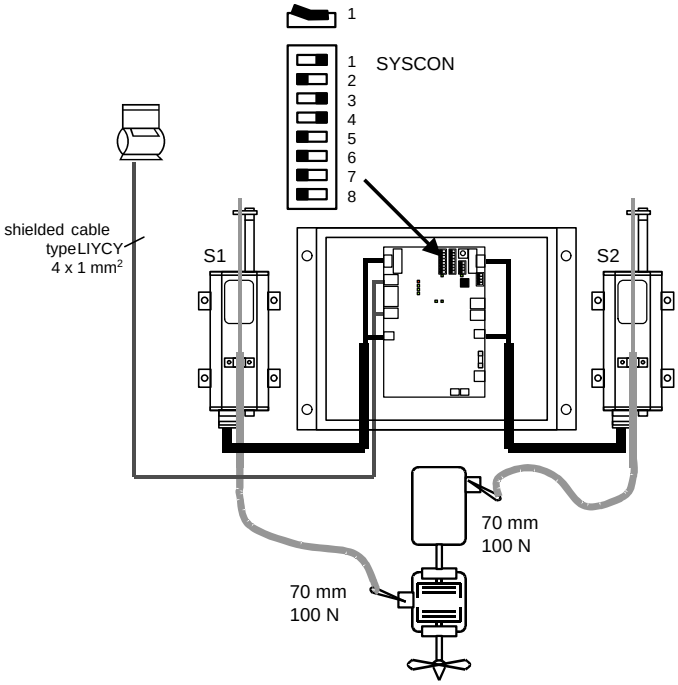
1.4 Operating advice
Do not reach into the actuator while it is in operation. You risk injuring.

The remote control MAREX SB has been designed for the control of Diesel engines. If it is applied for petrol or gas propulsion systems, its components must be installed outside the hazardous area. The instructions for hazardous areas have to be followed.

2 Overview
2.1 Single engine

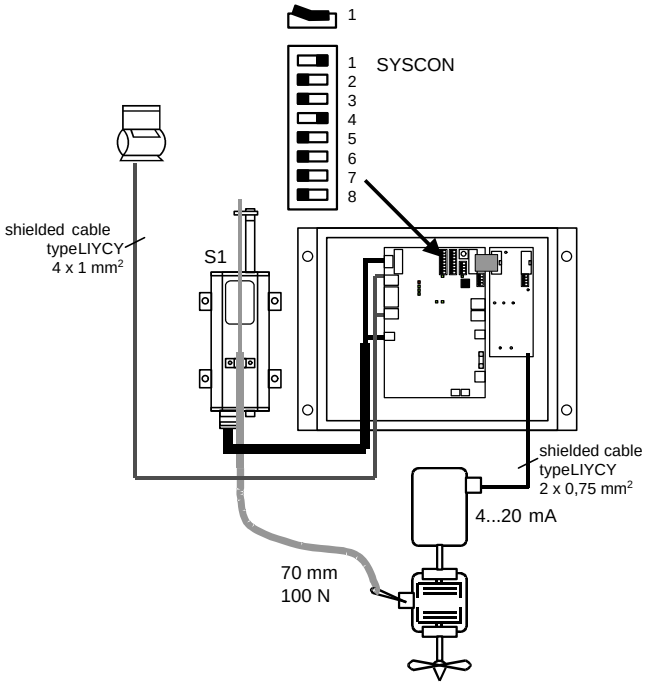
Single engine – mechanical throttle control and gear shifting

Throttle and gear shifting are operated by mechanical rods.



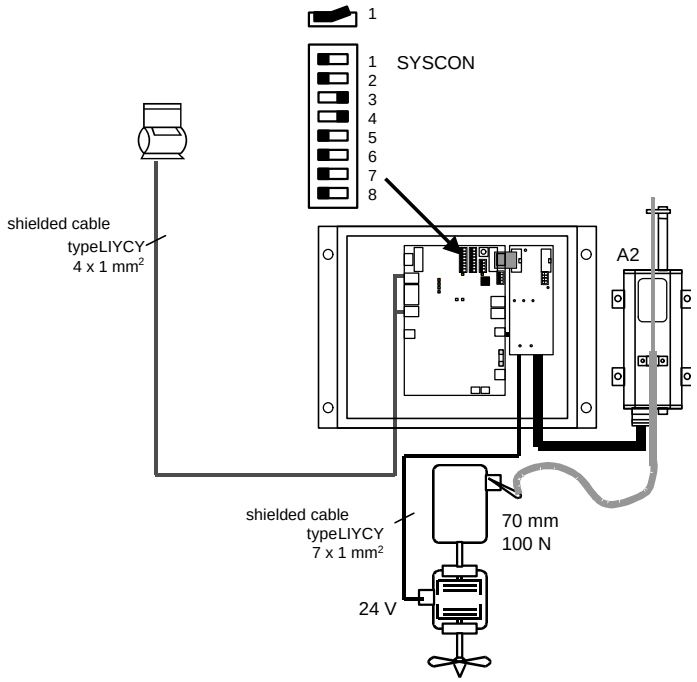
Single engine - electrical throttle control, mechanical gear shifting

The throttle is adjusted electrically (4 ... 20 mA), the gears are shifted by mechanical rods.



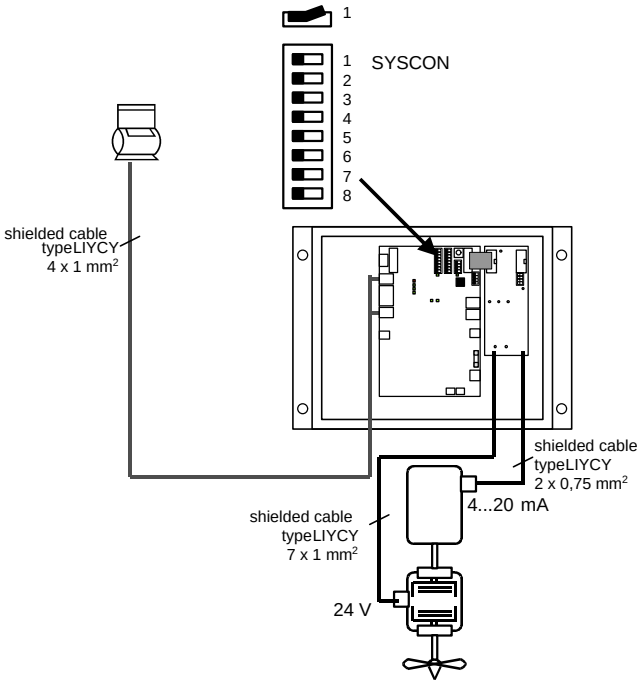
Single engine - mechanical throttle control, electrical gear shifting

Throttle is actuated by mechanical rods, gear shifting is controlled by 24 V-signals.



Single engine – electrical throttle control and gear shifting

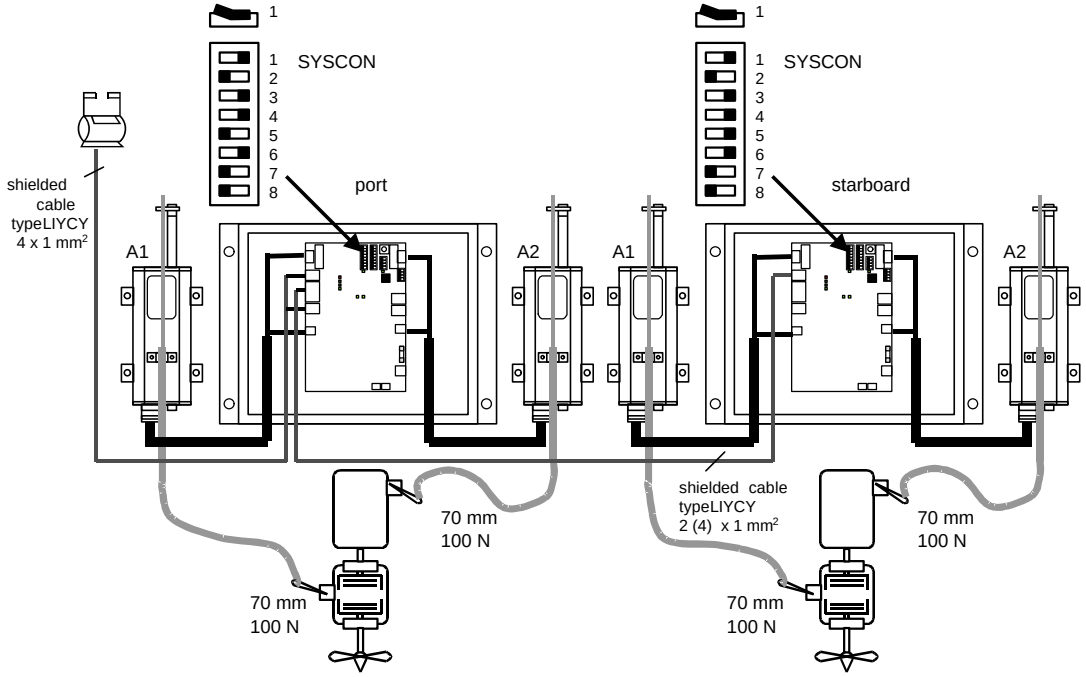
Throttle is adjusted electrically (4 ... 20 mA), the gears are shifted using 24 V-signals.



2.2 Twin engine

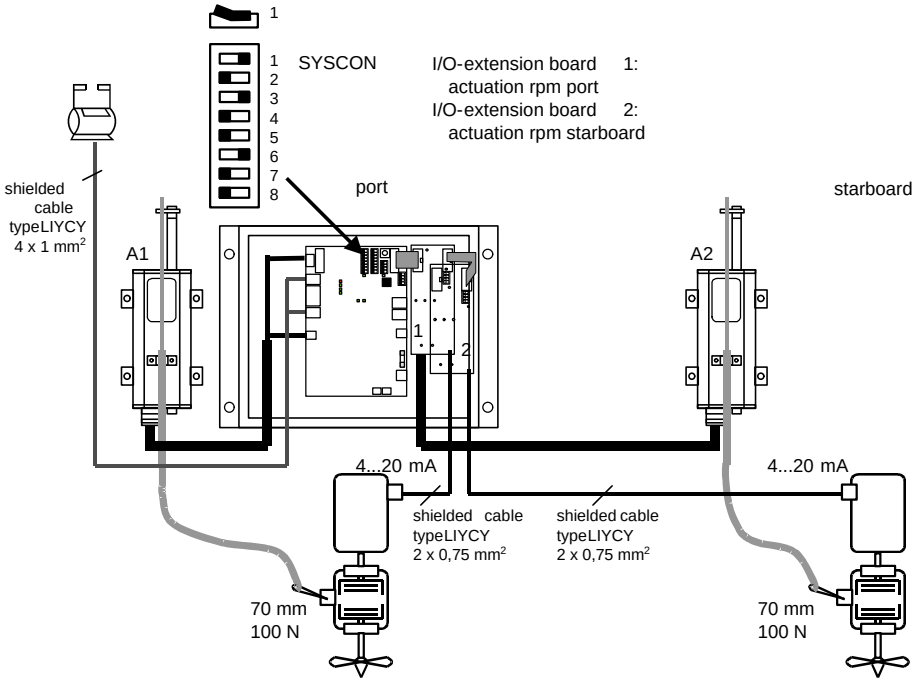
Twin engine – mechanical throttle control, mechanical gear shifting

Throttle and gear shifting are controlled by mechanical rods.



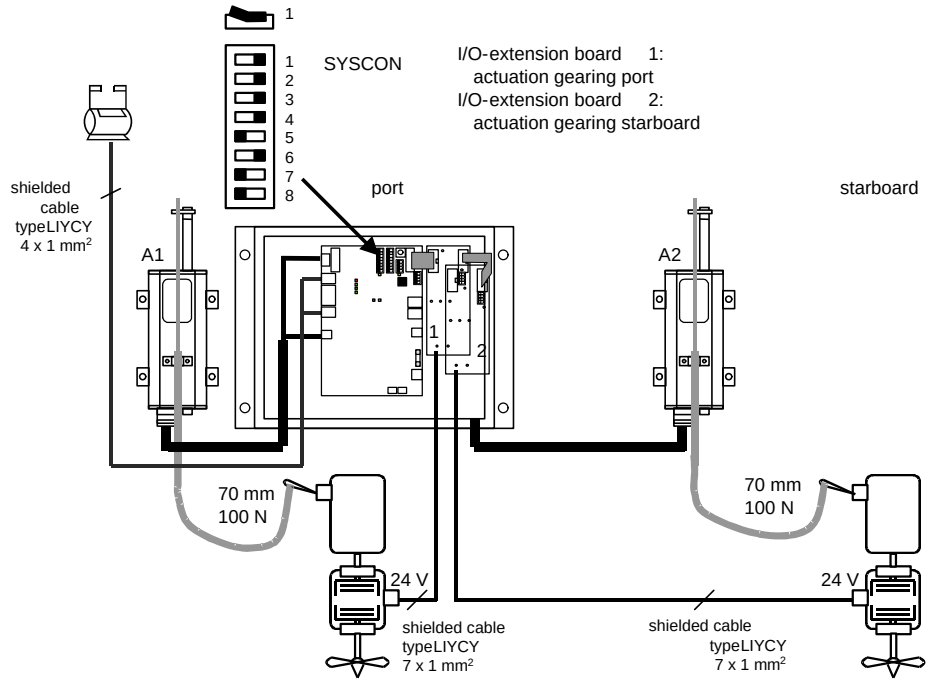
Twin engine – electrical throttle control, mechanical gear shifting

Throttle is actuated electrically (4 ... 20 mA), the gears are shifted by mechanical rods.



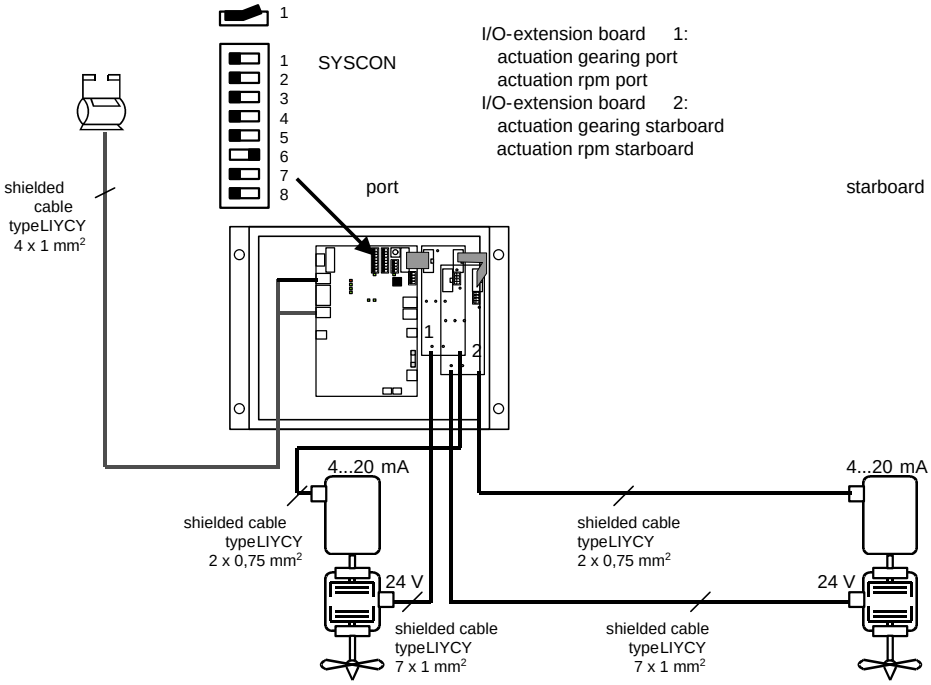
Twin engine – mechanical throttle control, electrical gear shifting

Throttle is adjusted by means of mechanical rods, gear shifting is controlled by 24 V-signals.



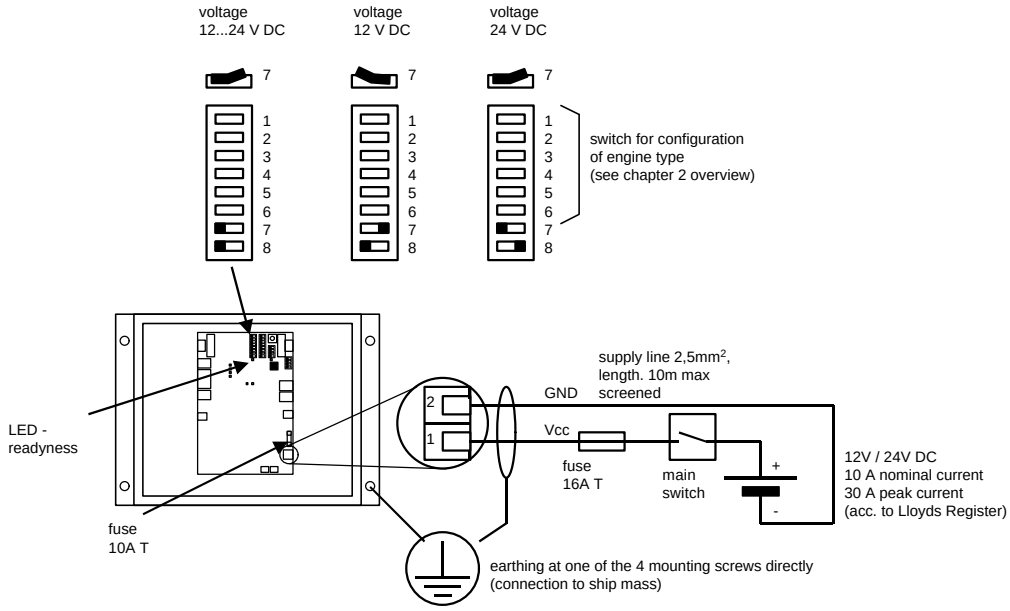
Twin engine – electrical throttle control, gear shifting electrical

Throttle is adjusted electrically (4 ... 20 mA), gear shifting is operated by 24V-signals.



3 Wiring

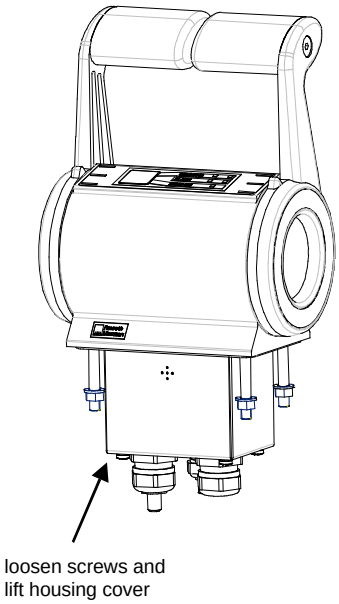
3.1 Voltage supply

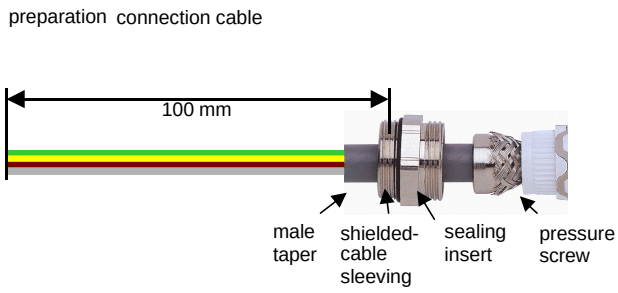


For systems approved by classification societies, the voltage range 12V or has to be selected. If the supply voltage exceeds or falls below the range by +30% or -25% respectively, a corresponding error message will be issued.

3.2 Control head

Advice how to mount the connecting cable





The data cable must be prepared as shown above. The cables must not be squeezed when assembling the components after the wiring.
The sealing of the housing must be fitted correctly to guarantee protection type IP65.

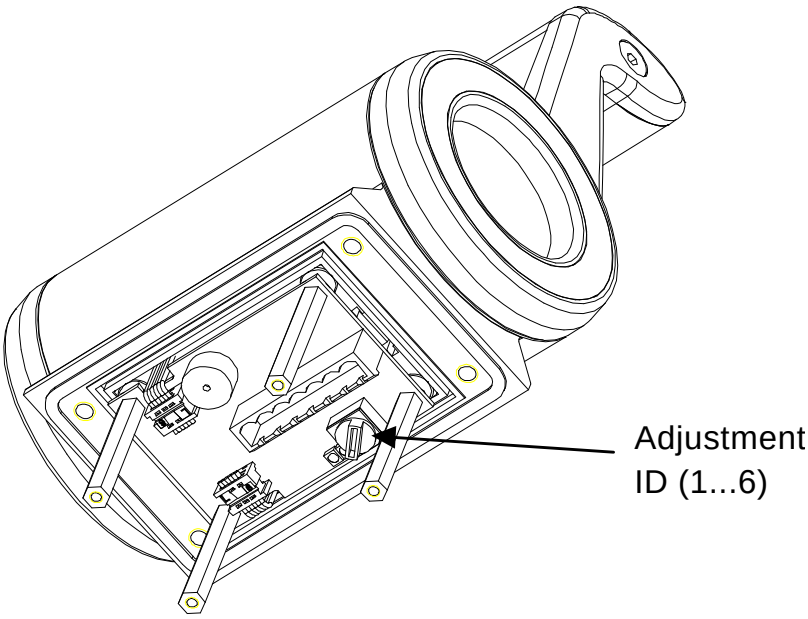
Entering the identification (ID)

To enable the control to identify the control heads, an individual ID must be entered once at every control head (e. g. control head bridge ID 1, control head port ID 2, control head starboard ID 3)

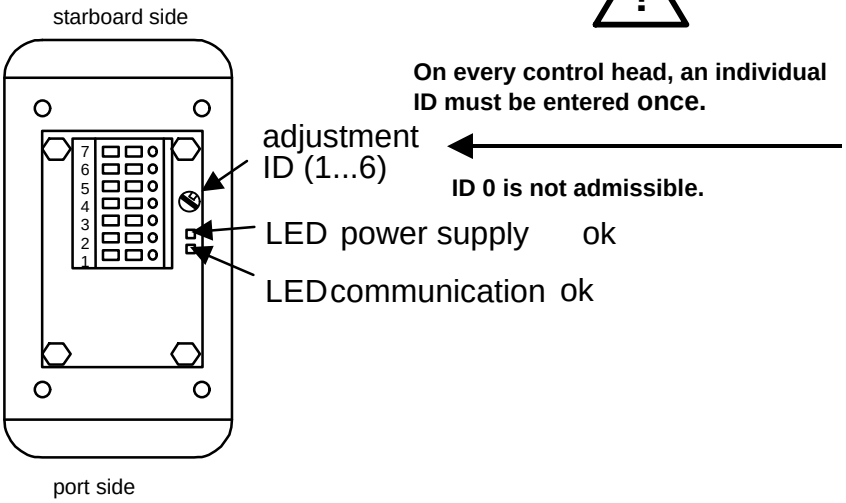
ID 0 is not admissible.

→ This procedure is not necessary, if the automatic ID setting is used. (Chapter 4.2)

To enter the ID, the housing cover must be removed.



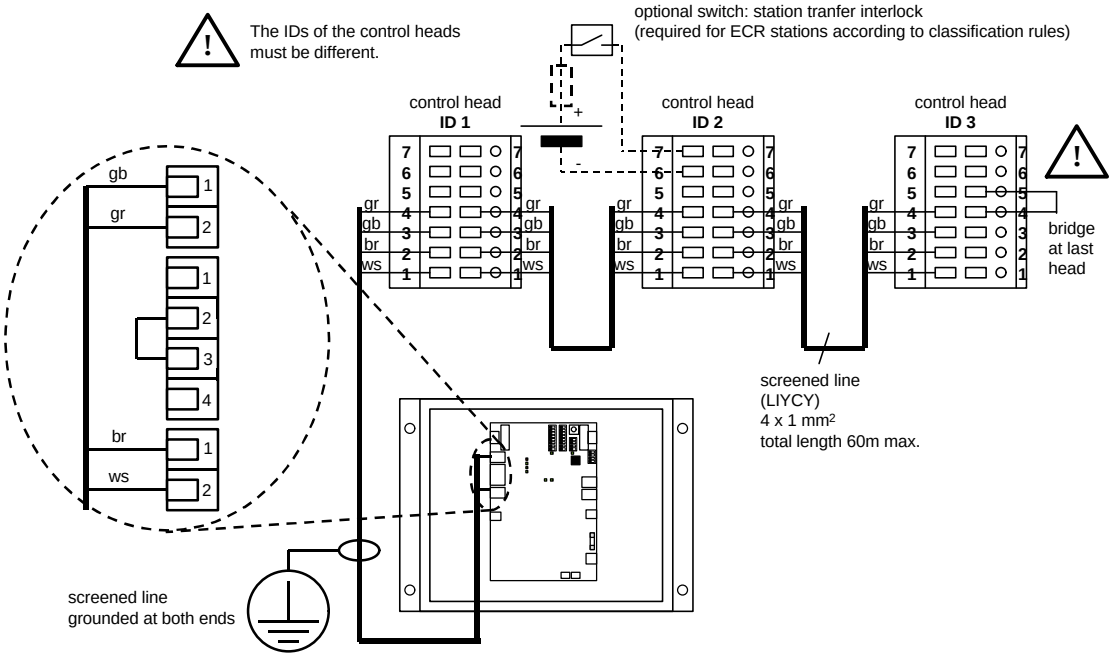
bottom side control head



On every control head, an individual ID must be entered once.

ID 0 is not admissible.

Wiring control head

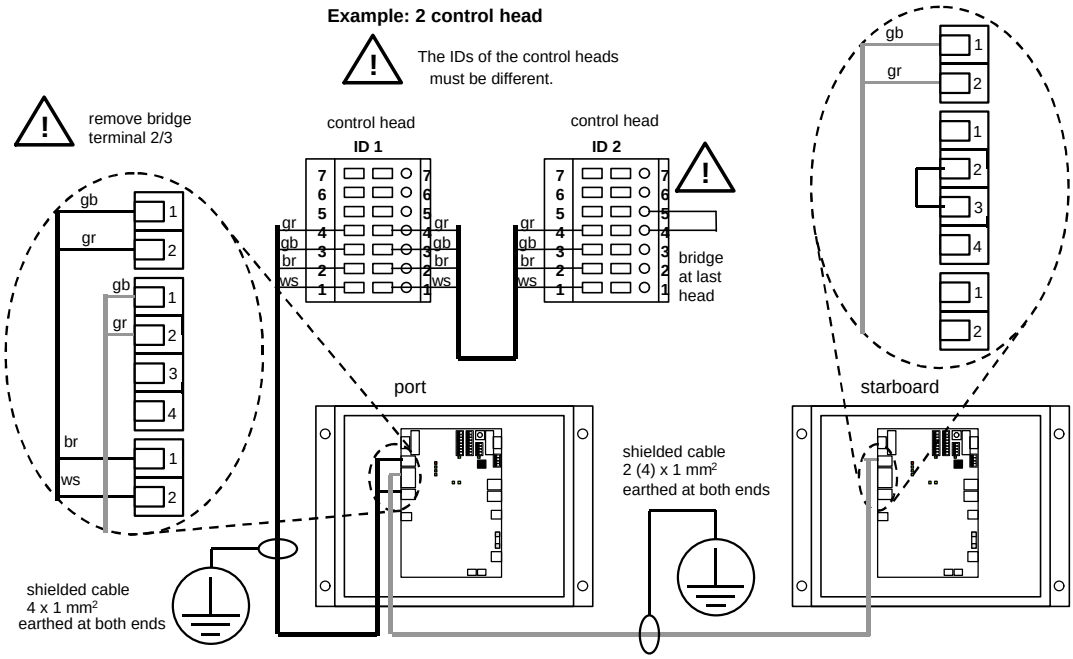

The IDs of the control heads must be different.
optional switch: station tranfer interlock (required for ECR stations according to classification rules)
control head ID 1
control head ID 2
control head ID 3
bridge at last head
screened line (LIYCY) 4 x 1 mm²
total length 60m max.
screened line grounded at both ends
gb
gr
br
ws

Terminal assignment control head

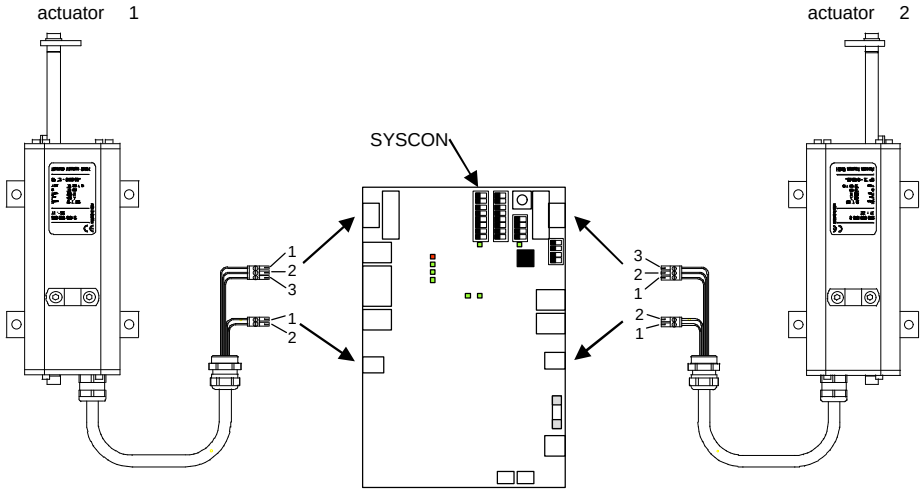
Terminal	Designation	Colour
1	0 V	white (ws)
2	+8 V	brown (br)
3	CAN –	yellow (gb)
4	CAN +	green (gr)
5	CAN end	
6	switch -	
7	switch +	

At the last control head, a bridge must be connected between terminals 4 and 5.

Special application: twin engine with mechanical throttle control and gear shifting


Example: 2 control head
The IDs of the control heads must be different.
remove bridge terminal 2/3
control head ID 1
control head ID 2
bridge at last head
port
starboard
shielded cable 2 (4) x 1 mm² earthed at both ends
shielded cable 4 x 1 mm² earthed at both ends
gb
gr
br
ws

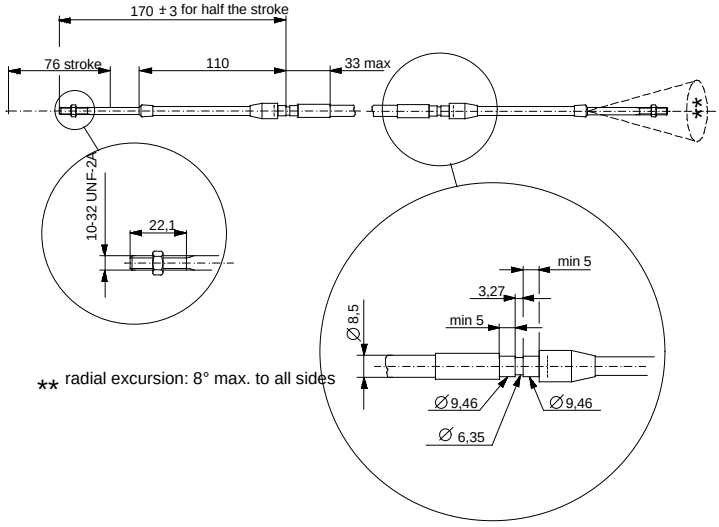
3.3 Mechanical throttle control and gear shifting



The setting of switchboard SYSCON (switches 1 – 6) assigns the function (speed or gear control) to the actuators (see chapter 2 overview).

3.3.1 Push-/pull-cable

The mechanical connection between actuator and lever for throttle adjustment or gear control at the engine is done by push-/pull-cables.



When laying push-/pull cables as few direction changes as possible should be made. The efficiency of the cables decreases with every deflection.

Deflection angle 90° usable force = 82% of the force applied
Deflection angle 360° usable force = 55% of the force applied

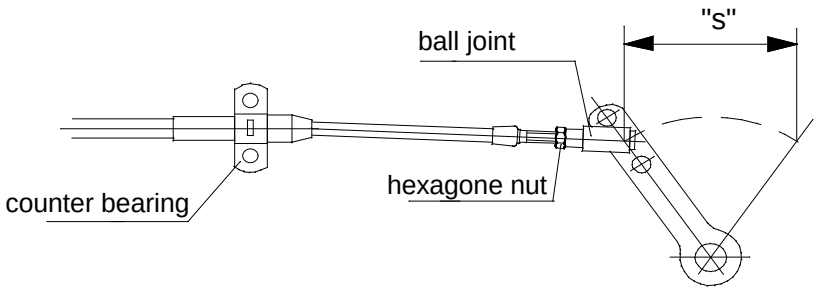
3.3.2 Mounting of the actuator

Mounting work may only be carried out if the actuator is idle.

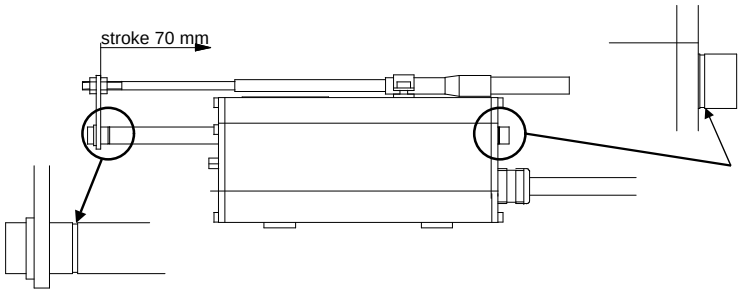
Risk of injury!

3.3.3. Connection at the throttle and gear adjusting lever

To fix the push-/pull-cable at the adjusting lever, a ball joint may be used.

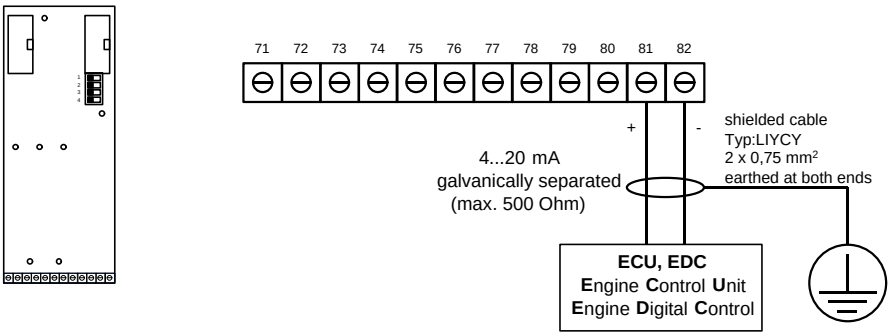


When adjusting the traveling range of the actuator (stroke), it must be ensured that both markings remain visible in the end positions.
The travel may not be blocked by exterior mechanical stops. Misadjustment may lead to blocking and distruction of the electric actuators.

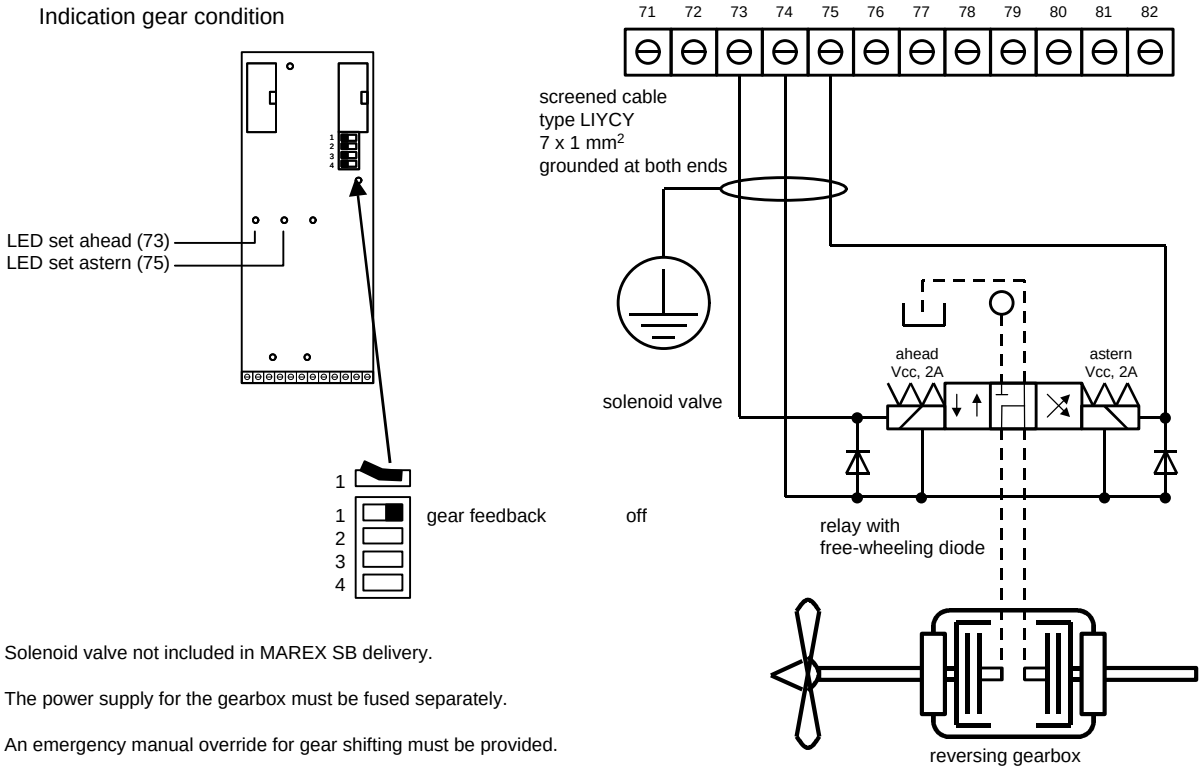


3.4 Electrical throttle control and gear shifting

Electrical throttle control



Electrical gear shifting without feedback



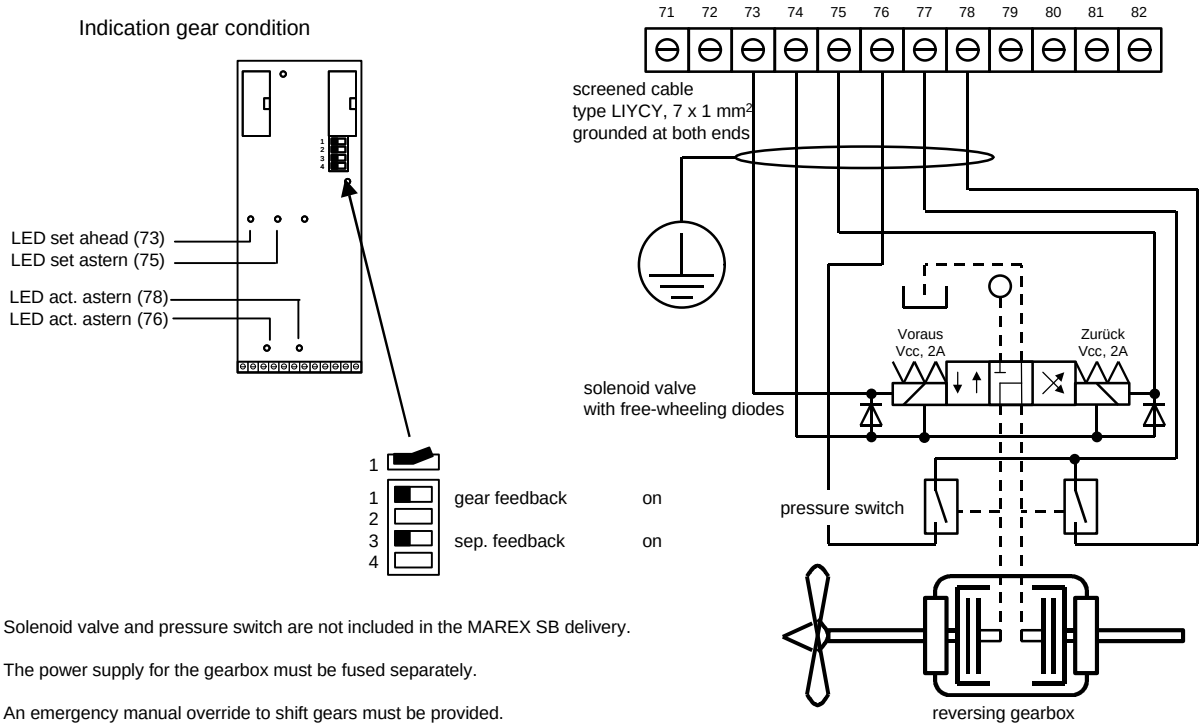
Solenoid valve not included in MAREX SB delivery.

The power supply for the gearbox must be fused separately.

An emergency manual override for gear shifting must be provided.

If inductive loads shall be switched, these must be provided with a free-wheeling diode.
If not, the digital output may be destroyed.

Electrical gear shifting with separate feedback



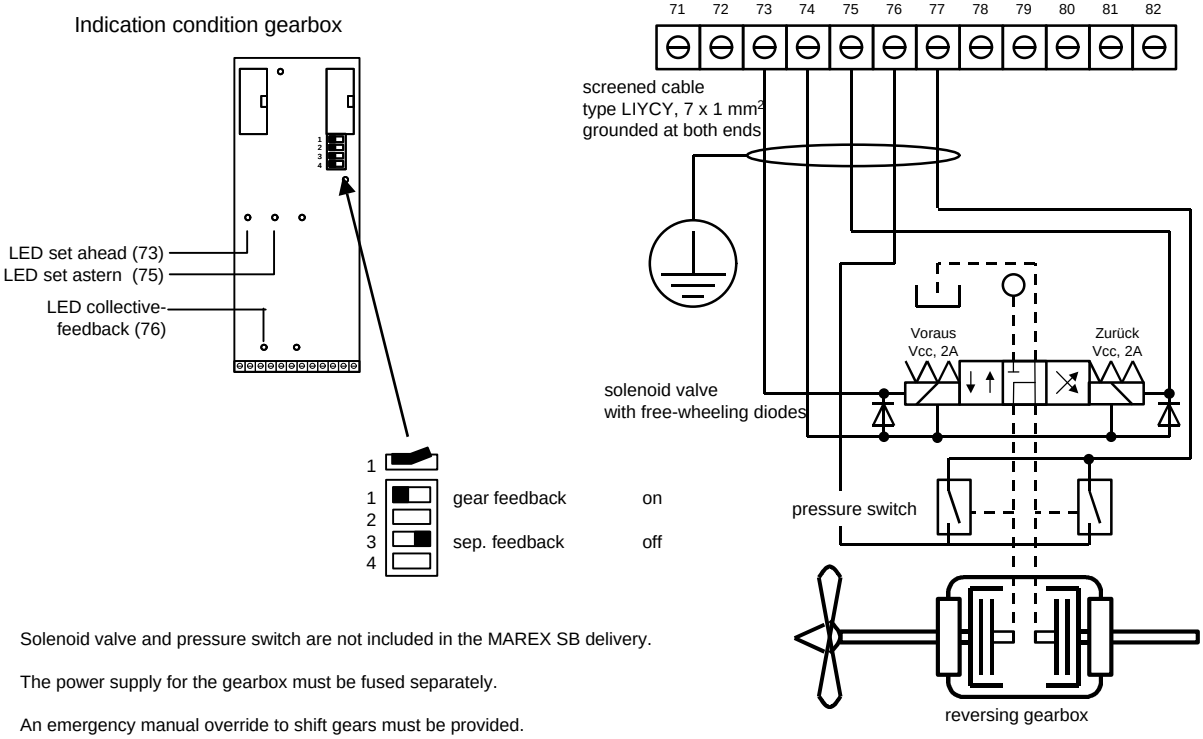
Solenoid valve and pressure switch are not included in the MAREX SB delivery.

The power supply for the gearbox must be fused separately.

An emergency manual override to shift gears must be provided.

If inductive loads shall be switched, these must be provided with a free-wheeling diode.
If not, the digital output may be destroyed.

Electrical gear shifting with collective feedback



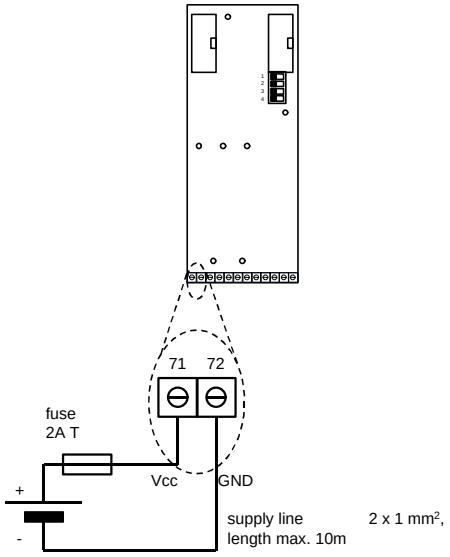
Solenoid valve and pressure switch are not included in the MAREX SB delivery.

The power supply for the gearbox must be fused separately.

An emergency manual override to shift gears must be provided.

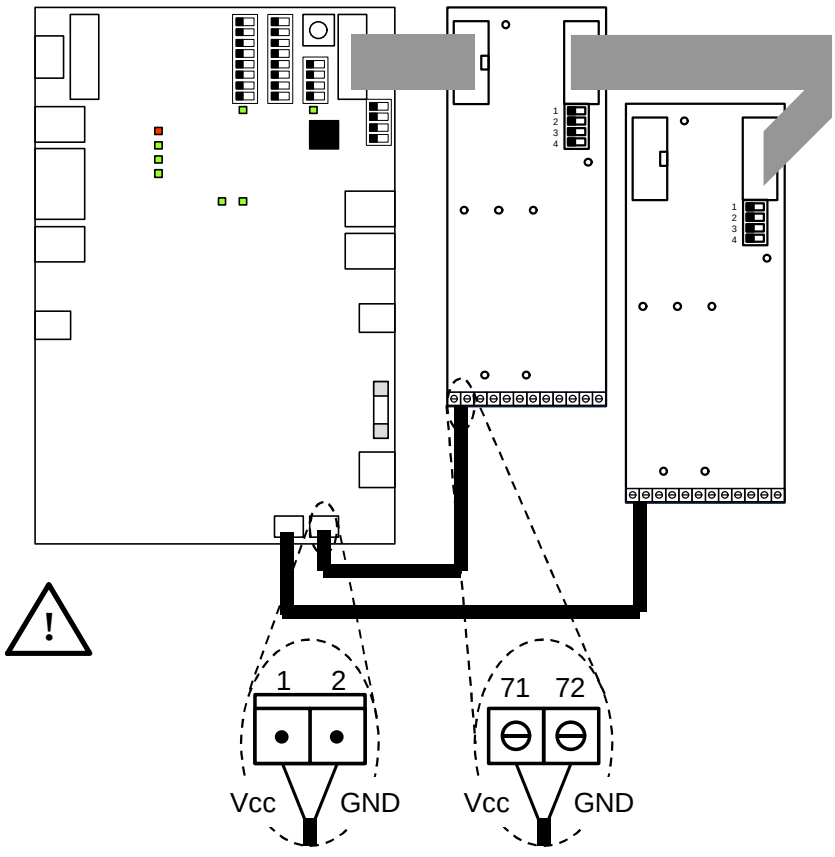
If inductive loads shall be switched, these must be provided with a free-wheeling diode.
If not, the digital output may be destroyed.

Power supply for electrical gear shifting



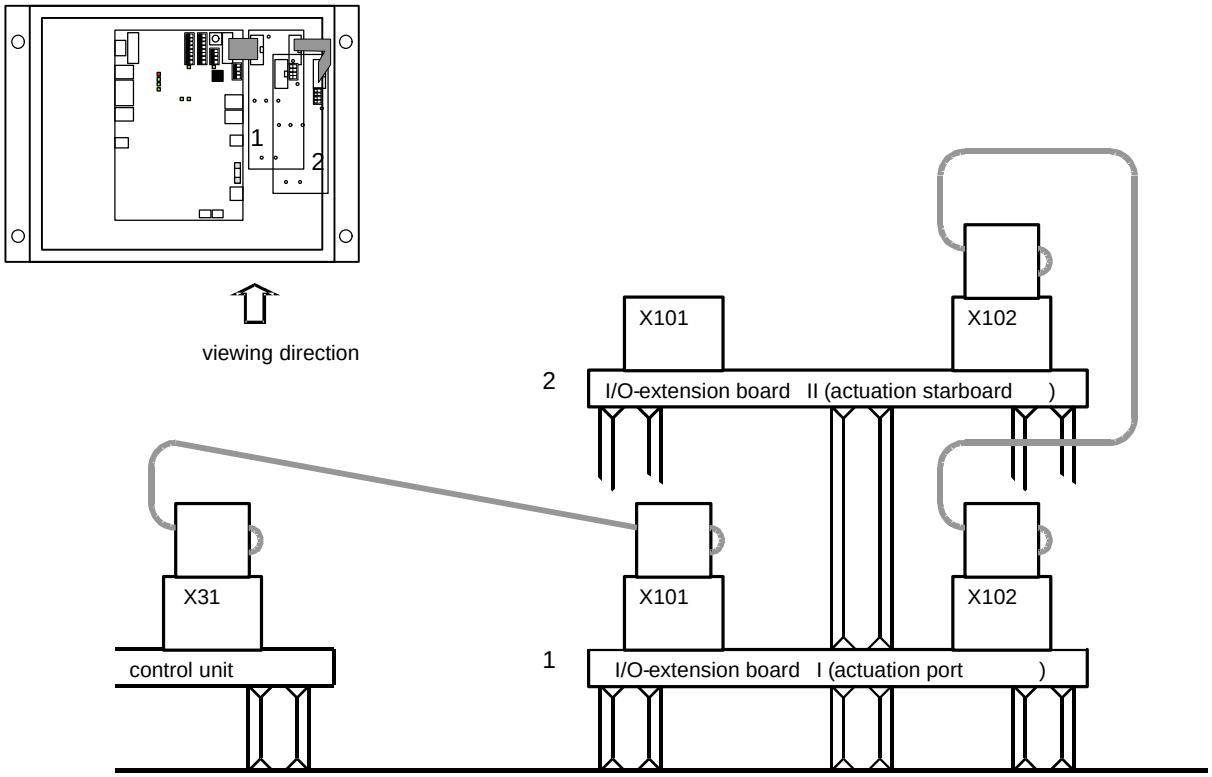
The power supply shown above is recommended according to the classification rules.

Alternatively, the control unit may supply the voltage for the electrical gear control:

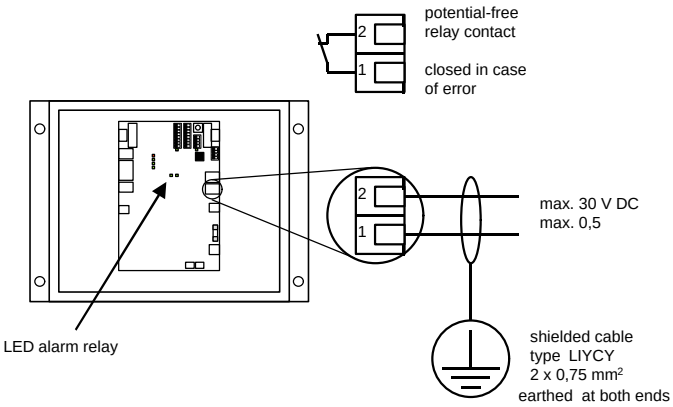


When the control unit supplies the voltage for the electrical gear control, the power supply is not protected by fuse. In this case, the control unit must be protected separately (see chapter 3.1 "power supply").

Mounting the I/O-extension boards

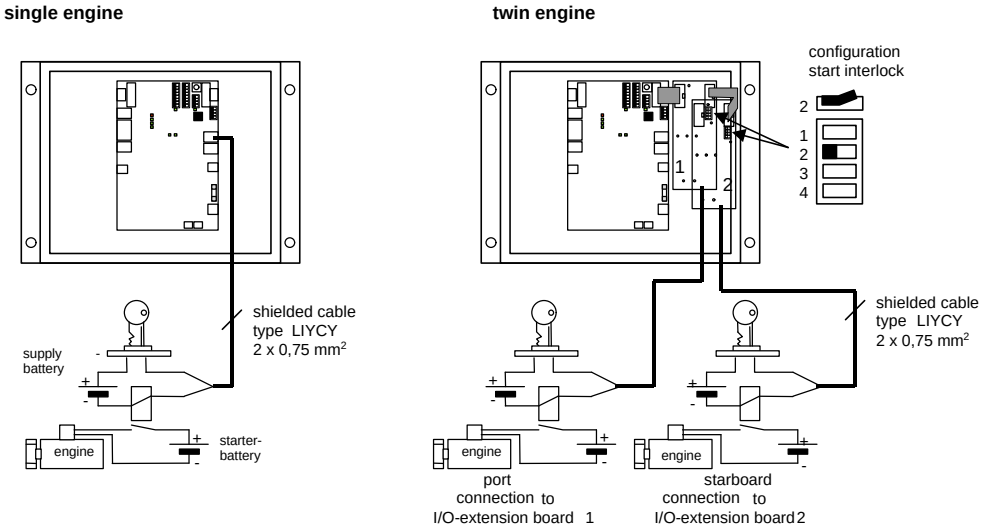


3.5 Alarm relays



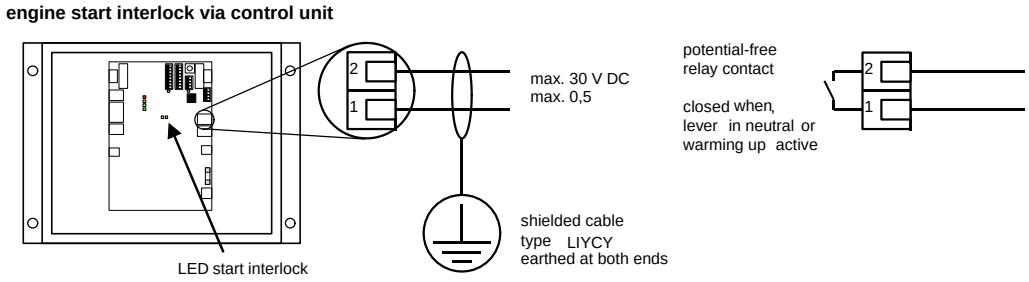
If inductive loads shall be switched, these must be provided with a free-wheeling diode.
If not, the digital output may be destroyed.

3.6 Engine start interlock



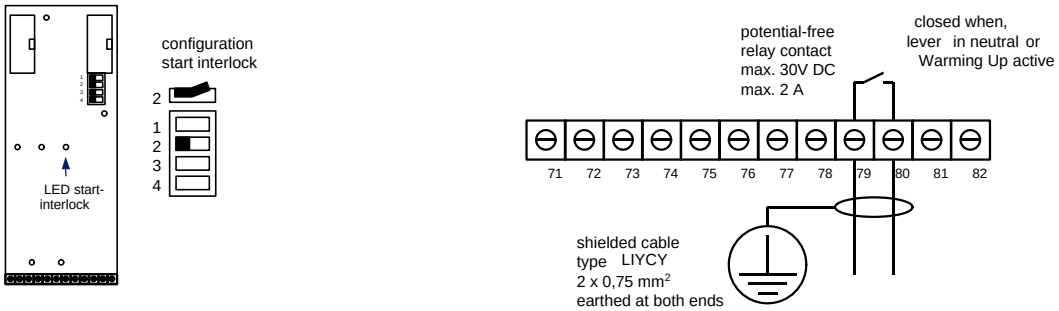
The relay "start interlock" is closed whenever the active control head is in neutral or warming up (see 5.4 "warming up") is active.

Wiring control unit



If inductive loads shall be switched, these must be provided with a free-wheeling diode.
If not, the digital output may be destroyed.

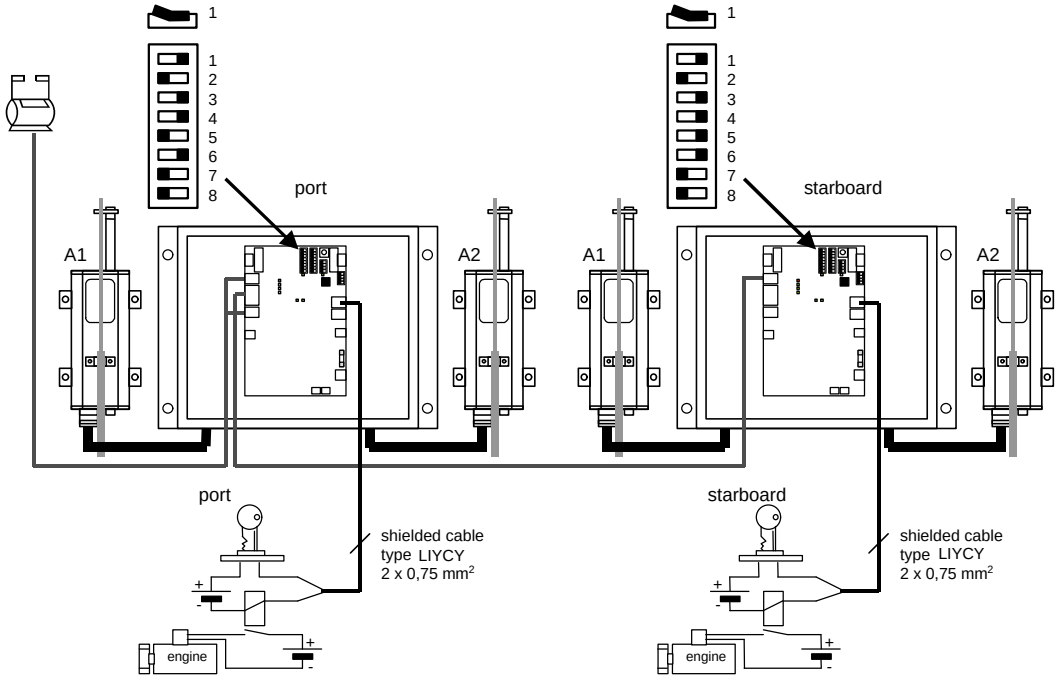
Wiring I/O-extension board



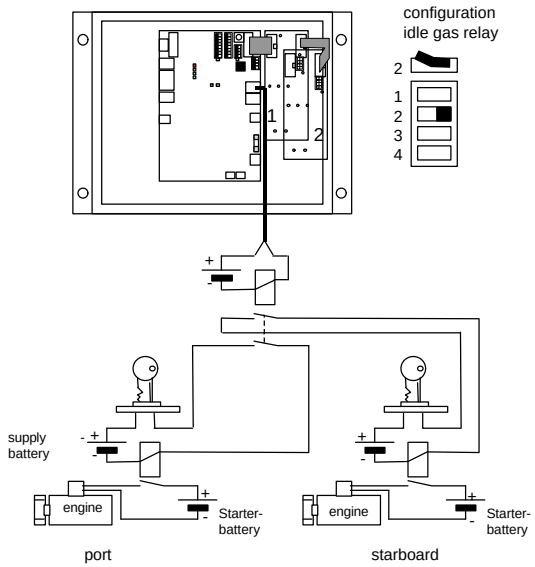
If inductive loads shall be switched, these must be provided with a free-wheeling diode.
If not, the digital output may be destroyed.

Two special cases must be considered when wiring the engine start interlock

Engine start interlock, special application 1:
Twin engine with mechanical throttle control and gear shifting

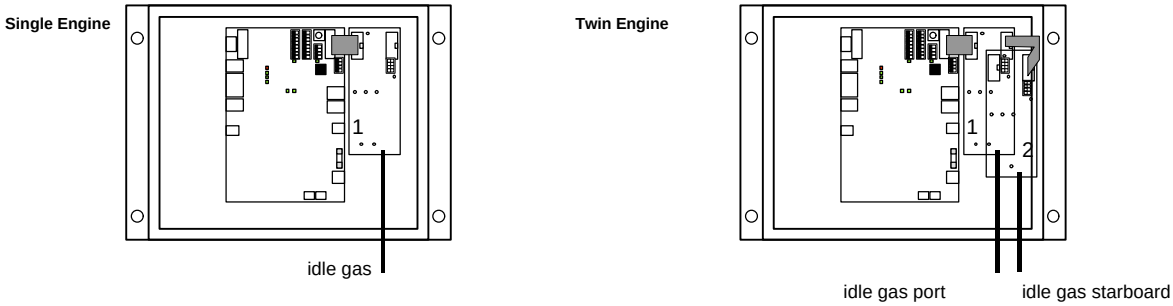


Engine start interlock, special application 2:
Using the function "idle gas relay" on twin engines



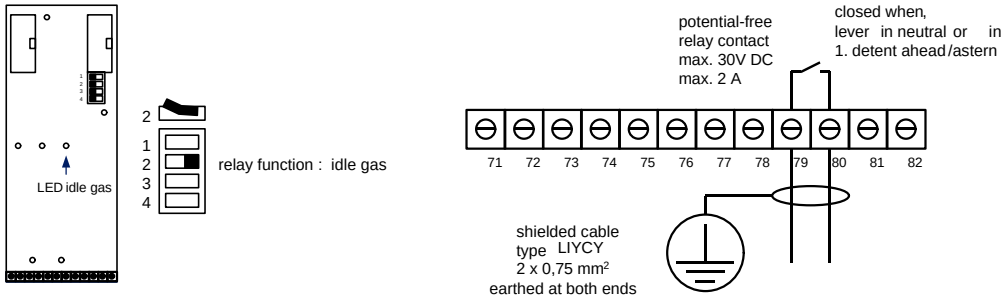
Engine start interlock will be released if both levers of the control heads (port and starboard) are in neutral position or warming up is active.

3.7 Idle gas relay



The idle gas relay is closed when the lever of the active control head is in neutral or in 1st detent ahead/astern.

Wiring I/O-extension board



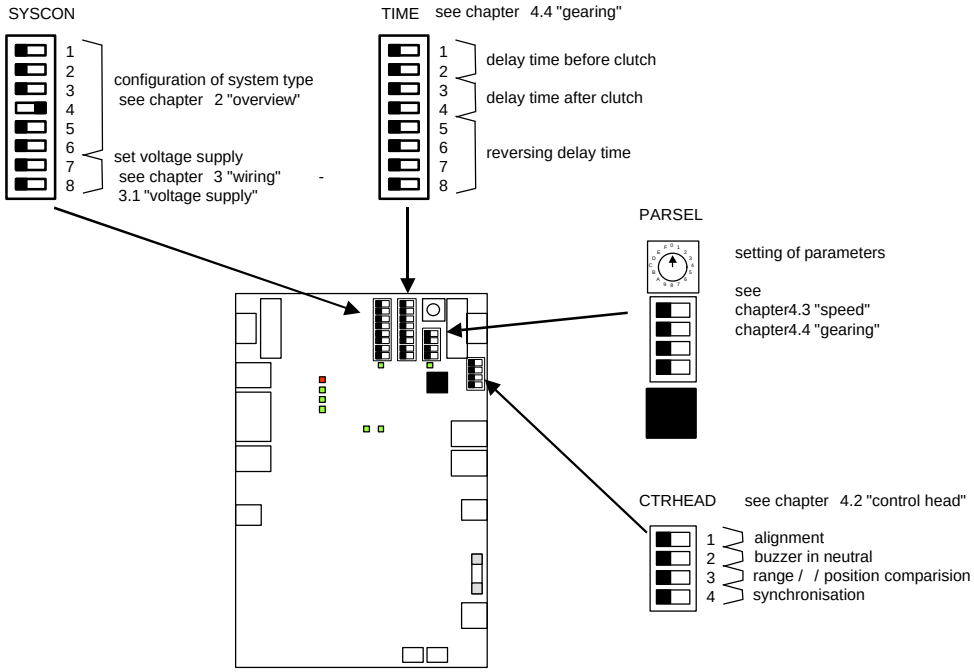
If inductive loads shall be switched, these must be provided with a free-wheeling diode.
If not, the digital output may be destroyed.

When the function "idle gas" is applied, the relay on the I/O-extension board is not available for the function "engine start interlock".

4 Adjustment

4.1 Hardware configuration

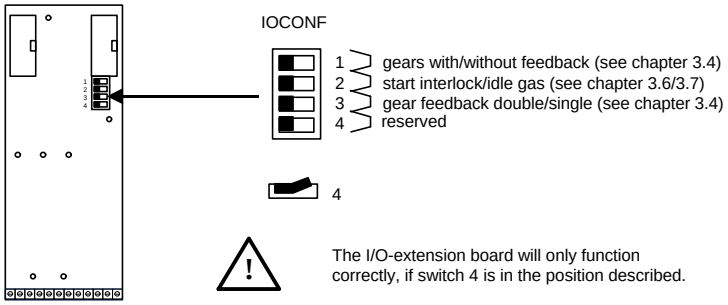
Possibilities of adjusting the control unit



The hardware is configurated by means of the switchboard SYSCON. The position of the switches can be changed only in deactivated condition.

The function of the switch board SYSCON (system configuration) is described in chapters 2 "overview ", 3 "wiring" and 3.1 "power supply".
The switch board **TIME** defines the delay times for the gear shifting. The function is described in chapter 4.4.
By the switches **PARSEL** (parameter selection), parameters are adjusted as e. g., for mechanical throttle control, idle and nominal speed and, for mechanical gear shifting, the gear positions ahead and astern. In addition, parameters for special functions are preset (see chapter 4.3 "speed", 4.4. "gearing").
The switchboard CTRHEAD (control head) determines the function of the control head (described in chapter 4.2 "control head").

Possibilities of adjusting the I/O-extension board



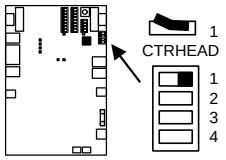
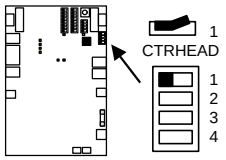
The switchboard IOCONF (I/O-configuration) defines the function of the electrical in-/outputs. They are described in chapter 3 "wiring" in the respective paragraph.

Switch 4 must be in the position as shown here.

4.2 Control head

Introducing the control heads

In order to inform the control about the number of control heads connected, these must be introduced. For twin engine controls with mechanical throttle control and gear shifting, the procedure has to be carried out at the portside system. The following steps have to be completed:

Step	Action	Diagram
1	Activation of the control	
2	CTRHEAD switch 1 to close (With two control units, only the port unit must be adjusted.)	
3	Wait 3 seconds	
4	CTRHEAD switch 1 to open (With two control units, only the port unit must be adjusted.)	

All control heads connected must be in condition "lamp test" (see chapter 5.2 "activation and request of control station").

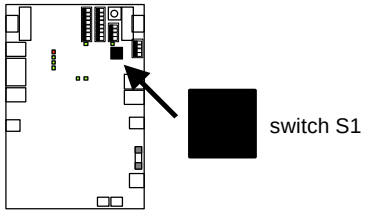
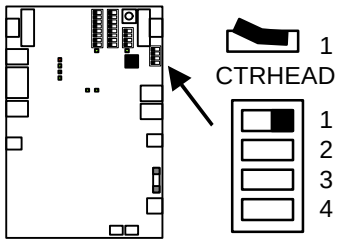
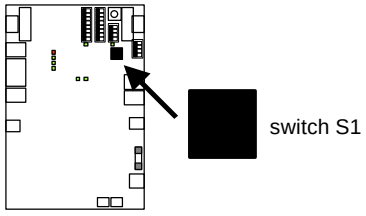
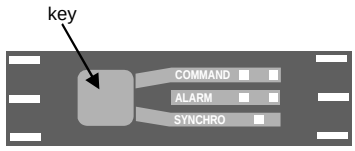
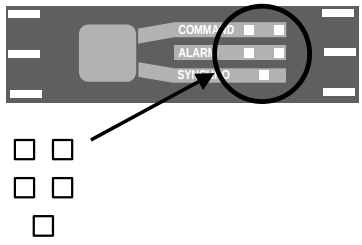
Special case "automatic ID-setting"
If automatic ID-setting shall be applied, the software versions stated below must be provided for control unit and heads:

Control unit: MSB V2.00 or higher
Control head: MSKG V2.00 or higher

With this feature, it is no longer necessary to define an ID at every control head as the system assignes IDs automatically to all heads connected.

After the automatic setting of control head IDs, it is no longer possible to combine control heads with software below V2.00 with heads providing a higher software version.

Procedure for automatic ID-setting

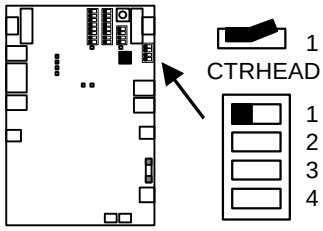
Step	Action	Diagram
1	Activate control.	
2	Hold down switch S1.	
3	Shift CTRHEAD switch 1 to close.	
4	Do not further operate switch S1.	
5	The control head buzzers sound at short intervals. In addition, the control head LEDs are active (see step 6) and flash in the same frequency as the buzzer.	
6	Press the keys of the control heads one after another.	
7	Signals after one keystroke: The buzzer stops. The ID which was stored is indicated by the LEDs of the control head. The LEDs flash slowly.	

ID Indication

LED off
LED steadily lighted
LED flashing

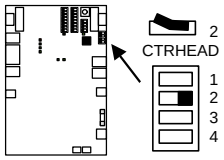
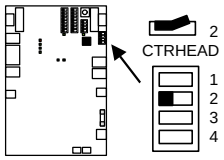
no ID assigned
no automatic ID set yet

ID 1 ID 2 ID 3 ID 4 ID 5

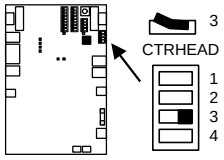
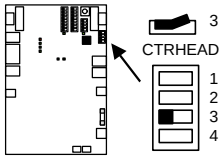
8	Shift CTRHEAD switch 1 to open.	

Buzzer in neutral

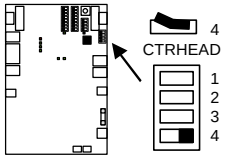
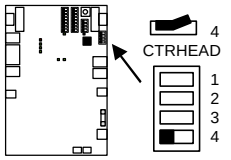
When the lever of the active control head is moved to neutral, a short buzzer sound can signal this.

Short sound, when lever in neutral (With two control units, only the port unit must be adjusted.)	
No sound (default condition) (With two control units, only the port unit must be adjusted.)	

Comparision of positions/ cruising ranges

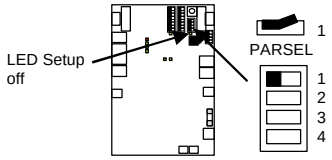
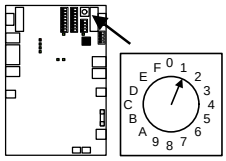
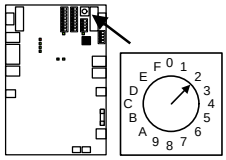
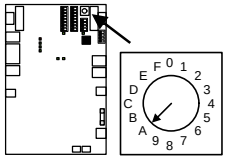
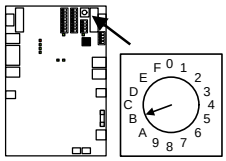
Compare position A change of control stations is possible only, if the lever of the new control station is set in the same cruising range (ahead, neutral, astern) and in the same position (maximum deviation 30%) as the lever of the active control station. According to the classification rules, this mode has to be selected. (With two control units, only the port unit must be adjusted.)	
Compare range A change of control stations is possible only, if the lever of the new control station is set either in the same cruising range (ahead, neutral, astern) as the lever of the active control station or in neutral position. (With two control units, only the port unit must be adjusted.)	

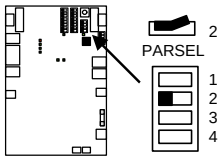
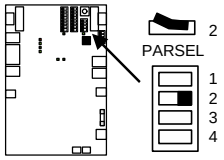
Synchronising

Synchronising active If the lever positions of the port and starboard control heads deviate at 10% maximum, the same nominal value will be preset automatically.	
No synchronizing (default condition)	

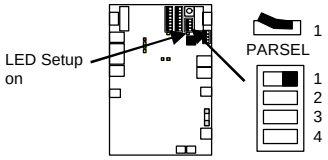
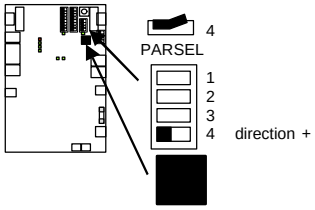
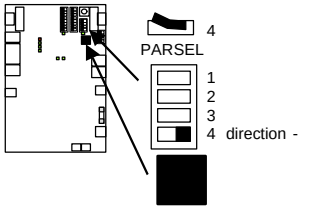
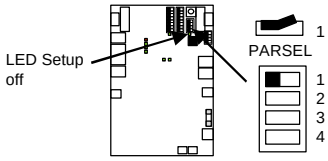
4.3 Speed setting

Generally, the parameters for speed setting can be set when the active control head is in neutral position. Idle speed, power boost and increased idle speed can also be set when the lever position is 1st detent ahead or astern. The nominal speed parameters may also be set when the lever position is full ahead or full astern.
For system configurated with 2 control units (mechanical throttle adjustment and gear shifting) each unit must be set separately.

Step	Action	Diagram
1	**Initial condition** Activation of control, command active, lever in neutral or 1st detent ahead/astern	
2	**Selection of the parameter to be adjusted** **Idle speed** PARSEL Turn switch to position 1 or	
	Nominal speed PARSEL Turn switch to position 2 or	
	Power boost PARSEL Turn switch to position A	
	Increased idle speed PARSEL Turn switch to position B	

3	**Selection of the system for which speed parameters shall be set** for single engines or twin engines: port system	
	for twin engines: starboard system	

During step 4, it is possible the engine revolutions adjust automatically.

4	**Change to SETUP-mode** The selected position will be reached. The LED Setup will be activated.	
5	**Adjustment of speed** Direction + Parameter will be adjusted as long as the key is pushed.	
	Direction – Parameter will be adjusted as long as the key is pushed.	
6	**Storing of parameter** Change to RUN-mode. LED Setup will be deactivated.	

When modifying the parameters "power boost" or "increased idle speed", the maximum speed for clutch engagement (see instructions of the gearing manufacturer) must be considered.

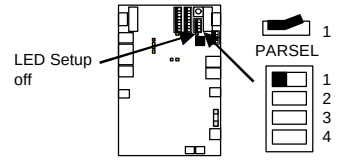
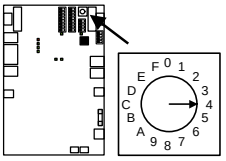
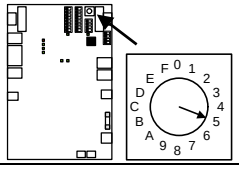
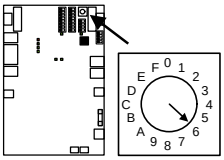
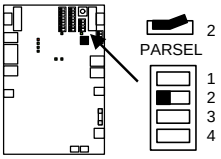
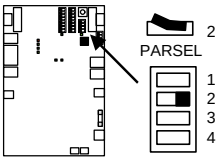
4.4 Gearing

Positions for actuating the mechanical gear shifting

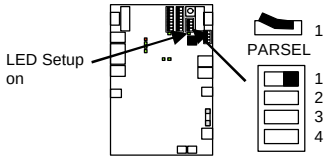
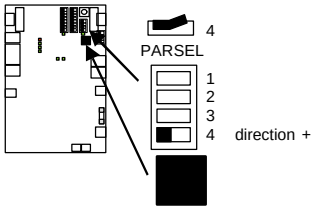
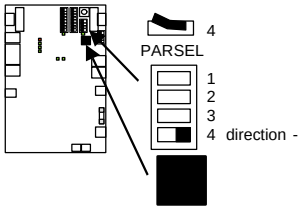
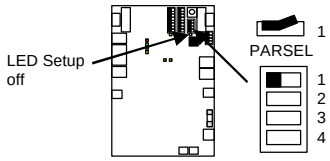
The push-/pull-cables at the actuators must be mounted in such a way that the neutral position of the gear system is actuated when the active lever is placed in neutral. For systems configurated with 2 control units (mechanical throttle control and gear shifting) each control unit must be set separately.

If the gearing is operated mechanically, the positions ahead and astern must be pre-adjusted. When doing so, the engines should be turned off.

The adjustment is possible only with the active control head lever in neutral position or if the active lever is in the position that corresponds to the gearing position which shall be adjusted (e. g. lever in ahead if gear position ahead needs to be adjusted).

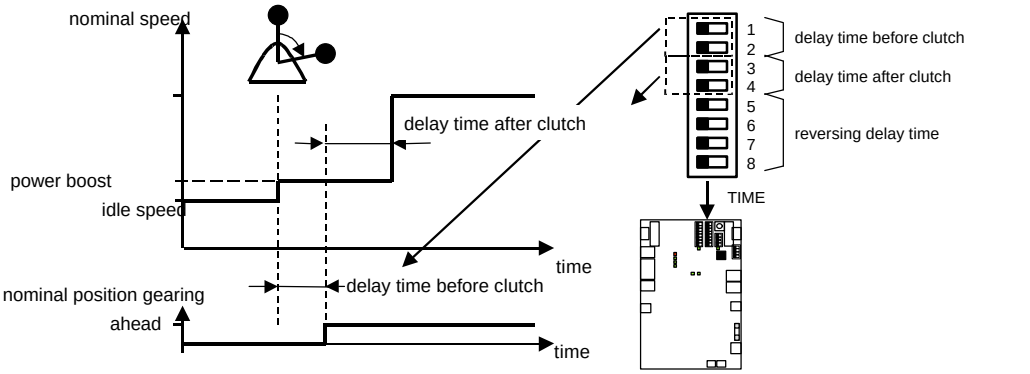
Step	Action	Diagram
1	**Initial condition** Activation of control, command active, lever in neutral or ahead, if gear position "ahead" has to be adjusted or lever in astern if gear position "astern" needs to be adjusted.	
2	**Selection of the parameter to be adjusted** **Ahead** Turn PARSEL-switch to position 4	
	Neutral Turn PARSEL-switch to position 5	
	Astern Turn PARSEL-switch to position 6	
3	**Selection of the system for which the parameters for gear actuation shall be set** for single engines or twin engines: portside gear system	
	for twin engines: starboard gear system	

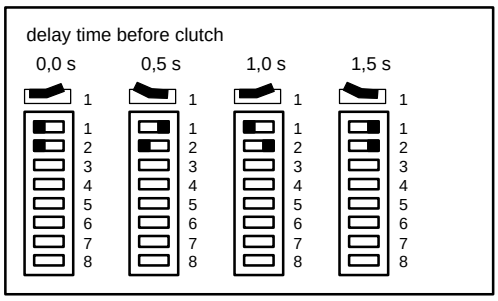
During step 4, it is possible that the gear position adjusts automatically, the driving engine should therefore be turned off.

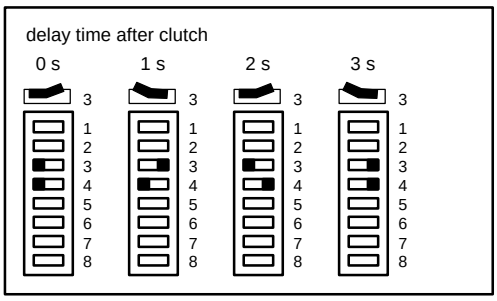
4	**Change to SETUP-mode** The selected position will be reached. LED Setup will be activated.	
5	**Adjusting the gear position** Direction + Position is adjusted as long as the key is pushed.	
	Direction – Position is adjusted as long as the key is pushed.	
6	**Storing of parameter** Change to RUN-mode LED Setup will be deactivated.	

Delay times for gear shifting

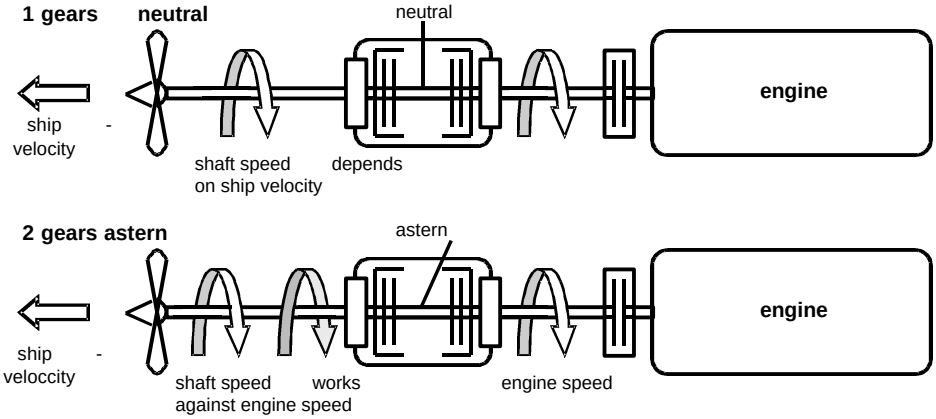
The delay time *before* clutch engagement must be long enough to ensure that a parameterized speed acceleration (see chapter 4.3 "speed adjustment") can be completed safely. The delay time *after* clutch engagement must be long enough to ensure the gearing has shifted safely. (This is important if there is no feedback from the gearing.) In case of a feedback signal, the "delay time after clutch engagement" will begin only after the feedback signal has been received. The setting is evaluated only by the portside system (for twin engines with mechanical throttle control and gear shifting).





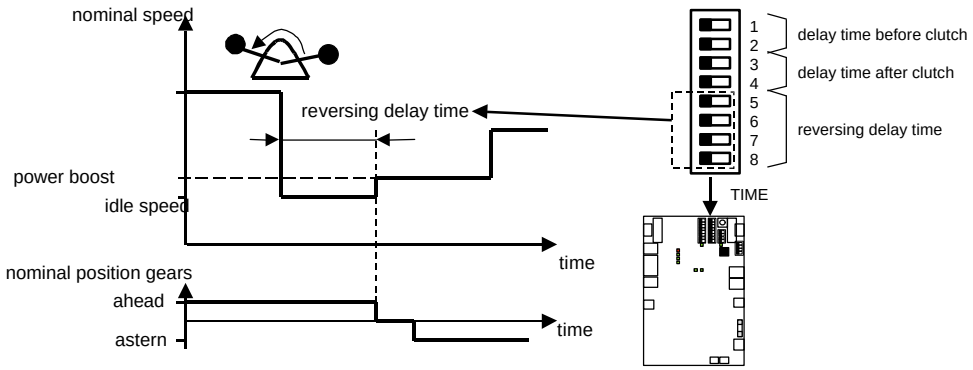


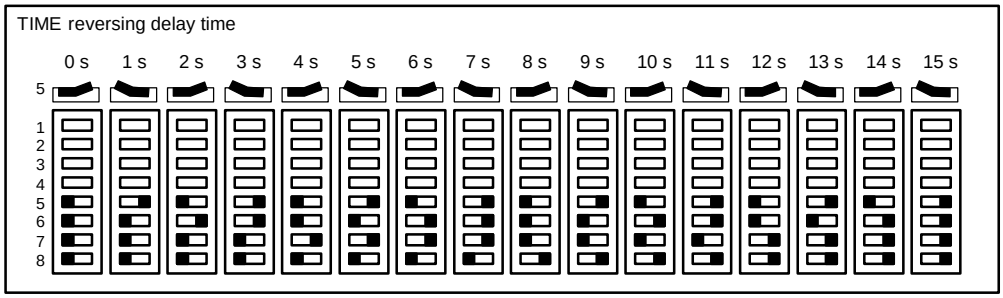
Conditions when reversing from ahead to astern:
When reversing from ahead to astern, the gearing is at first shifted to neutral, the shaft is disengaged from the engine (1). As the ship continues to move ahead, the propeller is driven like a windmill by the water streaming against it so that the shaft continues to turn. When the gears are then shifted to astern, the engine must work against the shaft which is still turning. In an unfavourable case, the engine might stall.



To avoid stalling the engine, the control can wait an adjustable time (reversing delay time) before reversing. The delay time depends on the given lever position of the control head.
The reversing delay time must be determined experimentally during a sea trial. For this, the ship must accelerate from 1st detent ahead to full ahead. The time, the ship needs to reach 2/3 of its maximum speed, has to be preset as reversing delay time. Afterwards, reversing maneuvers need to be carried out covering the full speed range.

During the reversing maneuvers, start with a slow speed first and increase gently. If necessary, the reversing delay time must be adjusted (lengthened, if the engine revolutions drop too heavily or shortened if no deceleration of the engine speed is recognisable.
If the reversing delay time is too short, clutch, gearing and engine may be damaged, if it is too long, the manoeuvrability may be restricted.

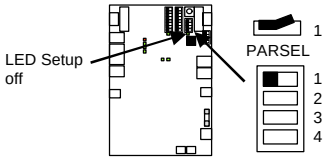
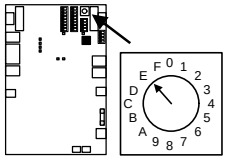
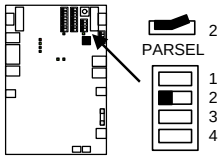
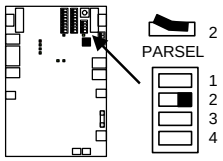
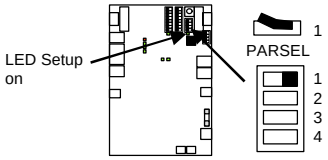
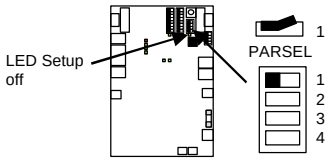




For applications with 2 control units, only the portside system must be adjusted.

4.5 Reset to default

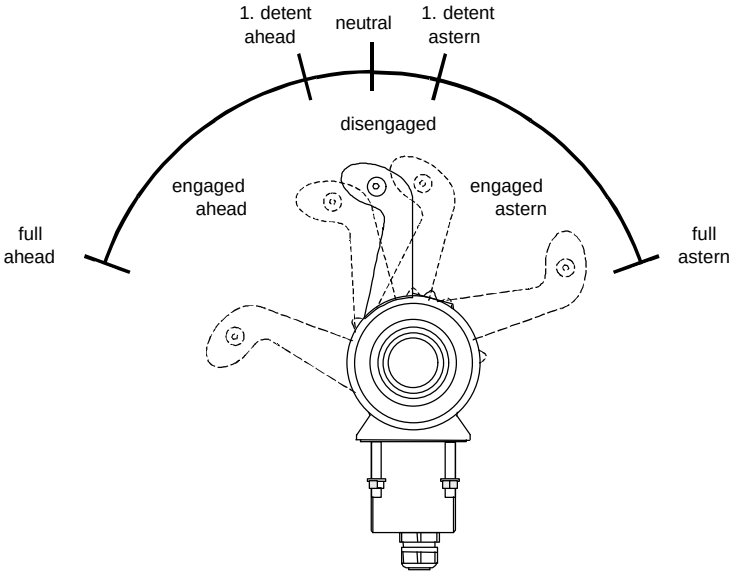
Resetting to default will reset the speed and gearing control values to their delivery status. This procedure is irreversible.
A reset to default may be done only if the driving engine is turned off. In case of mechanical controlling, the push-/pull-cables should be disconnected.

Step	Action	Diagram
1	**Initial condition** Activation of control, command active, lever in neutral	
2	**Selection default set-up** PARSEL Turn switch to position E.	
3	**Selection of the system to be reset** for single engines or twin engines: portside system	
	for twin engines: starboard system	
4	**Change to SET-UP-mode** Default position will be reached. LED set-up will be activated.	
5	**Storing the default set-up** Change to RUN-mode. LED set-up will be deactivated.	

5 Operation

5.1 General

By means of the lever position both, speed and gear position, (ahead, neutral, astern) are pre-set.



The following elements are available as user interfaces:

Keys

- Command transfer
- Acknowledge alarm-buzzer
- Activate special functions

Command lamps

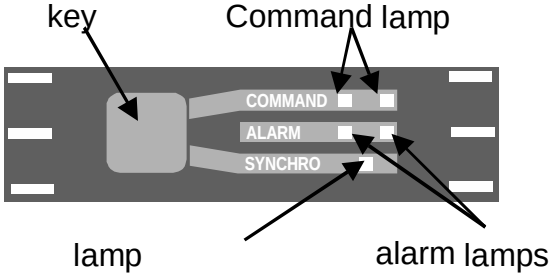
- Indication, if station is active.

Alarm lamps

- Indication, if an error exists.

Lamp synchronizing

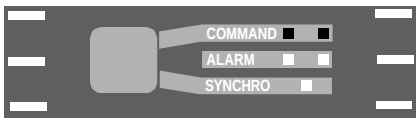
- Indication, if synchronizing is active.



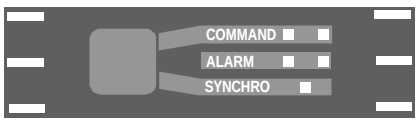
In case of twin control heads, the LED for command and alarm are assigned to the respective propulsion side.

In case of several control stations, passive stations must be distinguished from the active one. A command can always be set only from the active control station. If a passive control station is to set the command, a change of control station must be carried out before (see chapter 5.3).
On the active control station, the command lamps are on, on the passive station they are off.

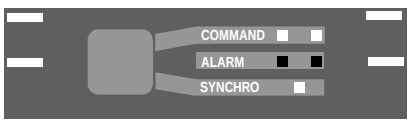
active station



passive station



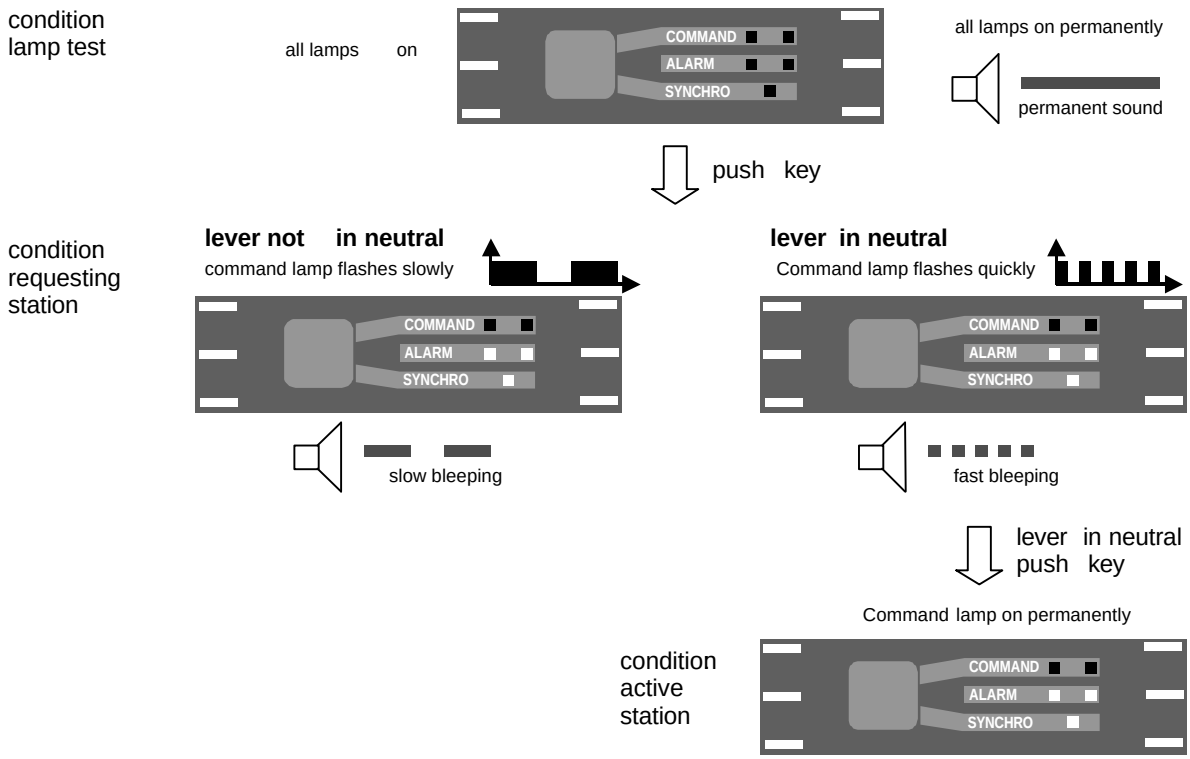
By means of an external switch (see chapter "wiring" - control head 3.2), the command transfer can be locked. If this is the case, the alarm lamps at the passive control station will be active.



5.2 Activation and request of control station

After switching on the power supply, all control heads which work correctly are in condition "lamp test" (all lamps and buzzer on). The command can be requested from every control station by pressing the key once. After the key has been pressed, the condition "lamp test" will end for all control heads.
On the control head on which the key has been pushed, the command lamps will flash and the buzzer sound. The lamps flash slowly and the buzzer sounds at slow intervals when the control head lever is not in neutral position.

By a slow flashing of the command lamp, the control head signals that the lever must be moved in neutral position first. If the levers are already in neutral, the command lamp will flash quickly and the buzzer sounds at high repetition. The command can be taken over by pressing the key again.



As soon as a control station has been activated, gear position neutral and idle speed will be selected. The command can then be set from the active control station (see chapter 5.1).

Note for control heads twin engine:
In this case, both levers must be moved in neutral. The function of the command lamps is assigned to the respective lever (port, starboard).

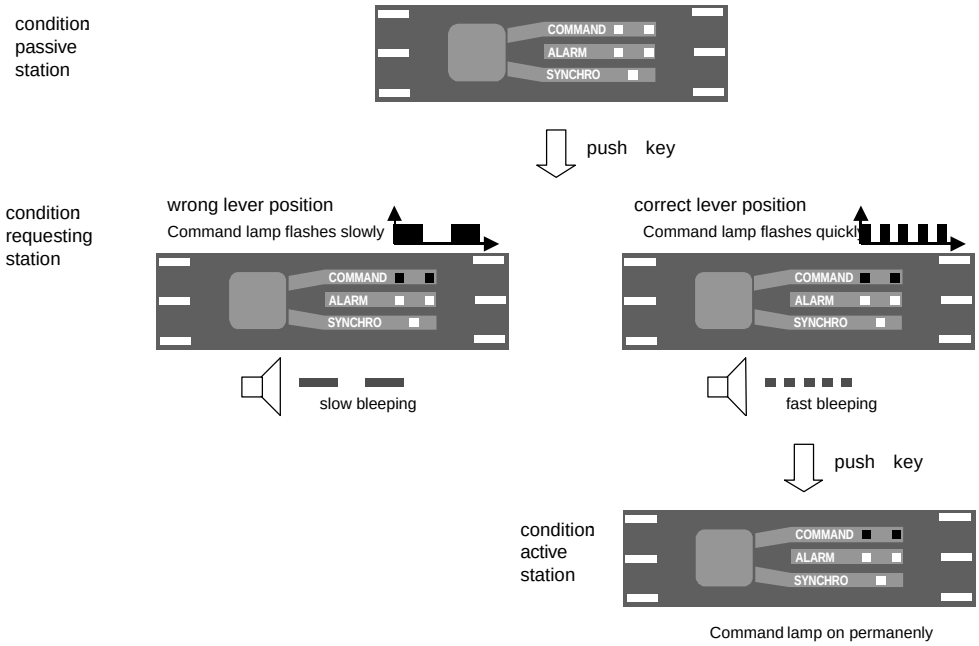
Note for possible error:
If, on a control head, the command lamps do not glow after the activation, it failed to contact the control unit. Wiring and ID (see chapter 3.2.) need to be controlled. If necessary, the procedure of entering the control heads into the system (see chapter 4.2) must be repeated.

If there is no functioning control head, the alarm relay will be activated.

5.3 Station transfer

A command transfer is possible in 2 different modes. Which mode is applicable, depends on the position of switch 3 on the switch board CTRHEAD (see chapter 4.2 control head – comparision of range / position). Always, the key on the passive control station must be pushed to change the control station.

Mode "compare direction"



If the lever of the passive control station is placed in a range which is not admissible for command transfer (the passive lever in astern when the active one is in ahead or neutral or the passive lever in ahead with the active one in astern or neutral), the buzzer will sound at long intervals and the command lamps flash at low repetition.

If the lever of the passive control station is in the correct position for a command transfer (the passive lever in ahead or neutral when the active lever is in ahead or the passive lever in astern or neutral while the active one is in astern), the buzzer will sound at short intervals and the command lamps flash at high repetition. By pressing the key again, the command will be taken over.

Mode "compare position"

In the mode "compare position", the position of the passive lever may deviate by 30% maximum from that of the active control head lever. In addition the range (ahead, neutral, astern) must correspond, before a command transfer can be carried out. It is not necessary to push the key a second time. The transfer will be executed as soon as the lever positions are correct.
This gives the operator the possibility, after the first actuation of the key, to move the lever until the correct range is found and the command transfers automatically. If the correct range is not found within 30 seconds, the command transfer will be stopped.

According to the classification rules, the given cruising command must not change during a command transfer. For this reason, classified ships must choose the mode "compare position".

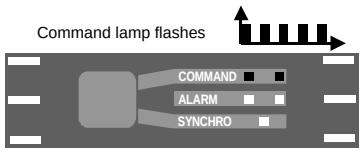
Note for twin engines:
In case of control heads with two levers, both levers must be placed correctly before the command can be transferred. The function of the command lamp is assigned to the respective lever. The buzzer will only sound at short intervals if both lever positions are correct.

5.4 Warming up

By means of the special function "warming up" a determined speed can be set without gear shifting. This function is necessary to warm up the engines.

To activate "warming up", the key must be pushed at the active control station and, at the same time, the lever moved in ahead or astern. Then the key may be depressed again. To turn the function off, the lever must be moved in neutral again. When doing so, the key must not be pushed.

When the function "warming up" is active, the command lamp flashes.



Note for twin engines: The function "warming up" can be activated and deactivated of both sides separately. The command lamp is assigned to the respective lever.

5.5 Increased idle speed

By the special function "increased idle speed" a higher idle speed can be selected. This function will be necessary if the driving engine shall operate a bow thruster in addition and the normal idle speed engine performance is not sufficient therefore.

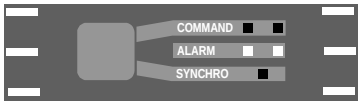
To turn this function on and off, the key on the active control station must be pushed. The function can be switched on in neutral only and switched off at any time.

The function "increased idle speed" is available only if it has been set up before (see chapter 4.3. speed). When this function has been entered, "synchronizing" cannot be deactivated again.

5.6 Synchronising

If, for twin engine systems, the positions of the port and starboard levers on the active control head deviate less than 10% from each other in the range of "ahead", the same nominal value (of the port lever) will be set.

If "Synchronising" is active, this will be indicated by the lamp "Synchro".



To switch off this function, the key on the active control station must be pushed.
The function will activate again as soon as the levers deviate 10% maximum from each other again at another position.

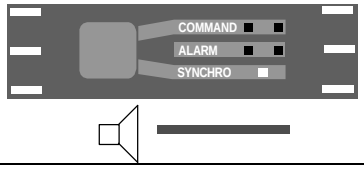
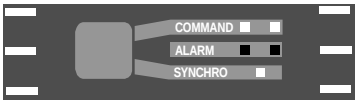
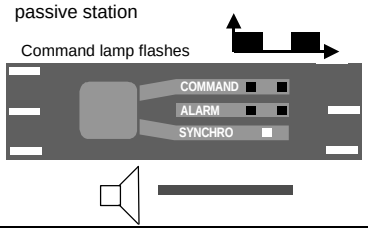
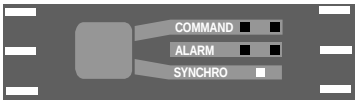
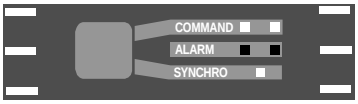
Note for „increased idle speed“: "Synchronizing" cannot be switched off if the function "increased idle speed" is active.

The function "Synchronization" is available only if it has been set up before (see chapter 4.2 "control head", synchronizing).

6 Error analysis

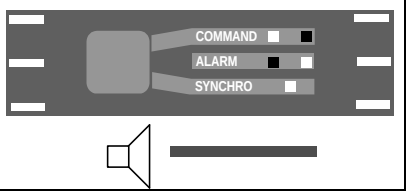
6.1 Errors at the control station

Two errors at the control stations must be distinguished:

Alarm	During an alarm, the setting of the cruising functions (speed or gearing) is disturbed. On the active control head, the red alarm lamp will be on and a buzzer will sound. The buzzer signal can be acknowledged and thus switched off by pushing the key. The command lamps indicate if the control head is active or passive, i. e. if this station can set commands or not. Special case: If the active control head is defective, the passive heads will activate their buzzer and will go over into the condition "request station".	active station  passive station  special case: passive station Command lamp flashes 
Warning	In case of a warning, the setting of the cruising function is not disturbed directly. The red alarm lamp will be active, but the buzzer will not sound.	active station  passive station 

For twin engines, the alarm and command lamp are assigned to the respective engine side so that several lamp reactions as described above may combine. The buzzer will be activated as soon as an alarm is signaled on one of the engine sides.

Example twin engine

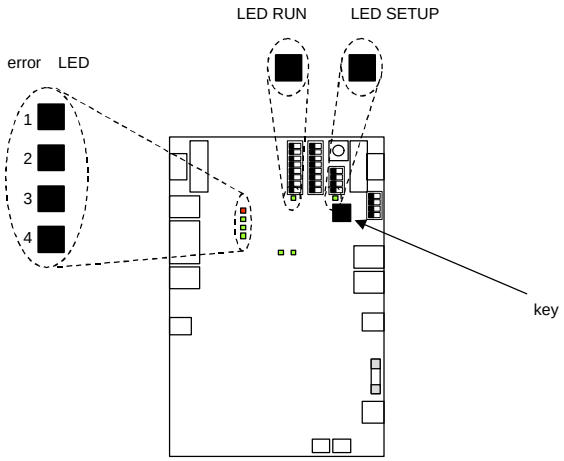
Port Alarm Starboard No Error	The starboard system is error-free and the control head is active. The port system is in alarm condition, no active command exists on this control station. Cruising commands can no longer be set from this station.	

In case of an alarm, the alarm relay is activated. In addition, idle speed is set and the gears are disengaged if the remaining function of the system permit it.

6.2 Error indication control unit

To indicate errors, 4 error LEDs are available altogether. The top LED is red to facilitate orientation.

The operation mode of the control is indicated by 2 additional LEDs (RUN, SETUP).
By pressing a key, further error messages can be displayed.



It must always be distinguished if the red LED1 flashes or stays on permanently.

■	LED on in mode "permanent on"
◪	LED on in mode "flashing"
□	LED off

Red LED 1 steady light

1 ■ 2 □ 3 □ 4 □	**Error type:** HARDWARE
	Error description: The board of the control unit contains a hardware fault.
	Error elimination: Replace board.
1 ■ 2 ■ 3 □ 4 □	**Error type:** PARAMETER
	Error description: Faulty parameter storage of the control unit.
	Error elimination: The parameters of the control must be re-set to default (see chapter 4.5). If afterwards the error is still occuring, the board of the control unit must be replaced.
1 ■ 2 □ 3 ■ 4 □	**Error type:** SOFTWARE
	Error description: The software of the control unit is defective (e. g. EPROM not plugged). The board of the control unit must be replaced.
	Error elimination: Switch the control on and off. If necessary, replace board of the control unit.
1 ■ 2 ■ 3 ■ 4 □	**Error type:** CAN
	Error description: The CAN-controller reports an error.
	Error elimination: Control the wiring to the control heads (chapter 3.2). Check the bridges (see chapter 3.2). There may be a short circuit in the wiring between single veins.

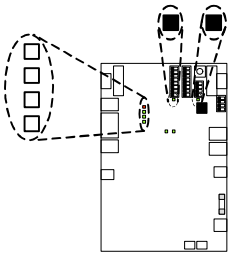
1 ■ 2 □ 3 □ 4 ■	**Error type:** ACTUATOR 1
	Error description: The system is configurated (see chapter 2) in such a way that actuator 1 (see chapter 3.3) directs mechanical gear shifting or speed setting. However, the control states an error in the operation of the actuator.
	Error elimination: Check the plugs of actuator 1 for correct connection to the board of the control unit (see chapter 3.3). If necessary, connect actuator 1 to the terminal of actuator 2 on the control unit. If the actuator works perfectly then, the board of the control unit is defective and must be replaced. If not, replace the actuator.
1 ■ 2 ■ 3 □ 4 ■	**Error type:** ACTUATOR 2
	Error description: The system is configurated (see chapter 2) in such a way that actuator 2 (see chapter 3.3) directs mechanical gear shifting or speed setting. However, the control states an error in the operation of the actuator.
	Error elimination: Check the plug of actuator 2 for correct connection to the board of the control unit (see chapter 3.3). If necessary, connect actuator 2 to the terminal of actuator 2 on the control unit. If the actuator works perfectly then, the board of the control unit is defective and must be replaced. If not, replace the actuator.
1 ■ 2 □ 3 ■ 4 ■	**Error type:** I/O-CARD 1
	Error description: The system (see chapter 2) is configurated in such a way that the I/O-extension board directs electrical gear shifting or speed setting (see chapter 3.4). However, an error is stated in the activation of I/O-extension board 1.
	Error elimination: Check cable between I/O-extension board 1 and the control unit (see chapter 3.4. electrical throttle control / gear shifting, installation of the I/O-extension board). If necessary replace cable or I/O-extension board.
1 ■ 2 ■ 3 ■ 4 ■	**Error type:** I/O-CARD 2
	Error description: The system is configurated (see chapter 2) in such a way that I/O-extension board 2 directs electrical gear shifting or speed setting (see chapter 3.4). However, an error is stated in the activation of extension board 2.
	Error elimination: Check cable between I/O-extension board 2 and 1 or I/O-card 1 and the control unit (see chapter 3.4 electrical throttle control / gear shifting, installation of the I/O-extension board). If necessary, replace cable or I/O-board.

Red LED 1 flashing

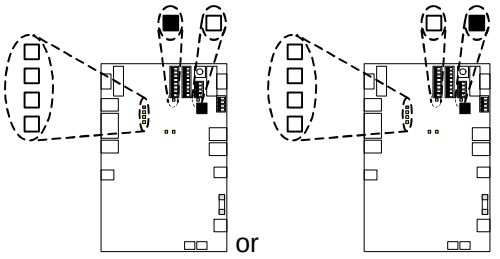
1 ◪ 2 ☐ 3 ☐ 4 ☐	**Error type:** SYN-CARD (warning only)
	Error description: No extension board for synchronizing found.
	Error elimination: Check cable from synchronizing board to board of the control unit (see instructions attached to the synchronizing board). If necessary, replace synchronizing board.
1 ◪ 2 ■ 3 ☐ 4 ☐	**Error type:** SYN-SIG (warning only)
	Error description: The synchronizing board cannot measure the speed correctly.
	Error elimination: Check cable to the speed sensor (see instructions attached to the synchronizing board). If necessary, replace speed sensor or synchronizing board.
1 ◪ 2 ☐ 3 ■ 4 ☐	**Error type:** ACT-CTR
	Error description: The control unit reports a total failure of the active control head.
	Error elimination: Check cable to the control head (see chapter 3.2). Control the necessary bridges (see chapter 3.2). Check LED power supply at the control head (see chapter 3.2). Check ID (see chapter 3.2). If necessary, replace control head.
1 ◪ 2 ■ 3 ■ 4 ☐	**Error type:** ACT-CTR-HW
	Error description: The hardware of the previous active control head reports an error (e. g. potentiometer defective).
	Error elimination: Replace control head.
1 ◪ 2 ☐ 3 ☐ 4 ■	**Error type:** POWER
	Error description: The supply voltage (see chapter 3.1) is beyond the admissible range (for 24V: 18 ... 31,2V, for 12V: 9 ... 15,6 V, if no voltage range has been selected: 9 ... 31,2V).
	Error elimination: Charge battery.
1 ◪ 2 ■ 3 ☐ 4 ■	**Error type:** TEMPERATURE
	Error description: The temperature is beyond the admissible range (-25 ... +70 °C).
	Error elimination: The control may only be operated within the admissible temperature range.

1 ◪ 2 □ 3 ■ 4 ■	**Error type:** TWIN
	Error description: The system was configurated for twin engines – mechanical gear shifting and speed setting (chapter 2). The communication between the control units port and starboard does not function.
	Error elimination: Check cable between the control units and the necessary bridges (see chapter 3.2 – special application twin engine with mechanical throttle control / gear shifting). Check power supply of the single control units (LED readiness, see chapter 3.1). If necessary replace synchronizing board.
1 ◪ 2 ■ 3 ■ 4 ■	**Error type:** SYSCON (warning only)
	Error description: The SYSCON switchboard which controls the system configuration (see chapter 2), was adjusted while the system was active. This is not admissible. It may only be adjusted in voltage-free condition. Or, the switchboard was turned to a value which was not admissible.
	Error elimination: If the SYSCON switchboard was misadjusted, it must be reset correctly according to chapter 2. If the change was done on purpose, the control must be switched on and off before the alteration can become effective.

In addition, warnings can be issued. In case of warnings, the red error LED 1 will not be activated. Furthermore, in case of a warning, the operation mode must be considered.

Mode Initialising (LED RUN and SETUP on) 	
1 □ 2 ■ 3 □ 4 □	**Error type:** TWIN-MASTER
	Error description: The SYSCON switchboard is misadjusted for twin engines with mechanical actuation at the starboard system.
	Error elimination: Reset the SYSCON switchboard correctly for twin engines with mechanical actuation at the starboard system (see chapter 2).
1 □ 2 □ 3 ■ 4 □	**Error type:** TWIN-SLAVE
	Error description: The SYSCON switchboard is misadjusted for twin engines with mechanical actuation at the port system.
	Error elimination: Reset the SYSCON switchboard for twin engines with mechanical actuation at the port system (see chapter 2).

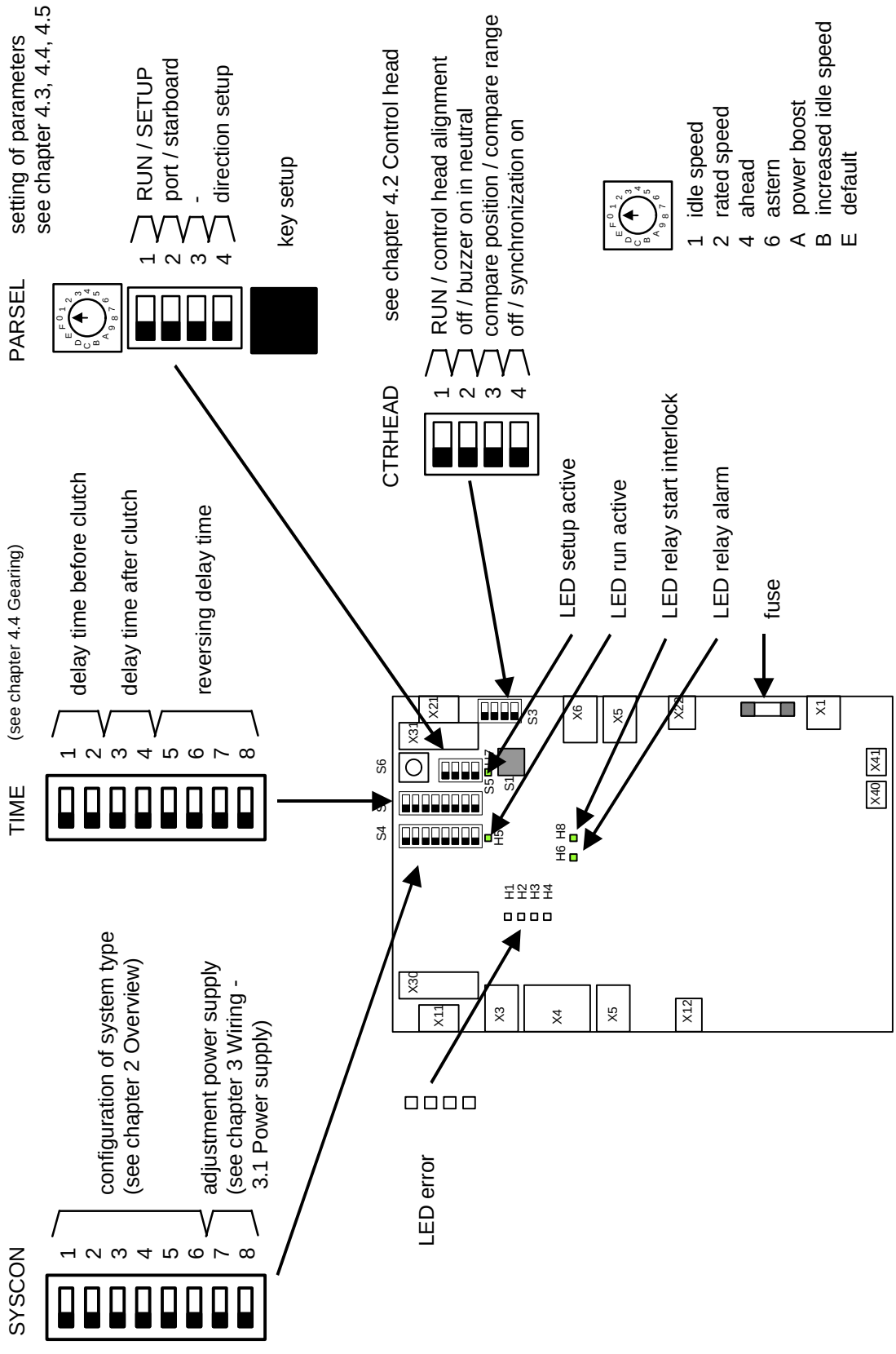
Mode RUN or SETUP (LED RUN or LED SETUP on)



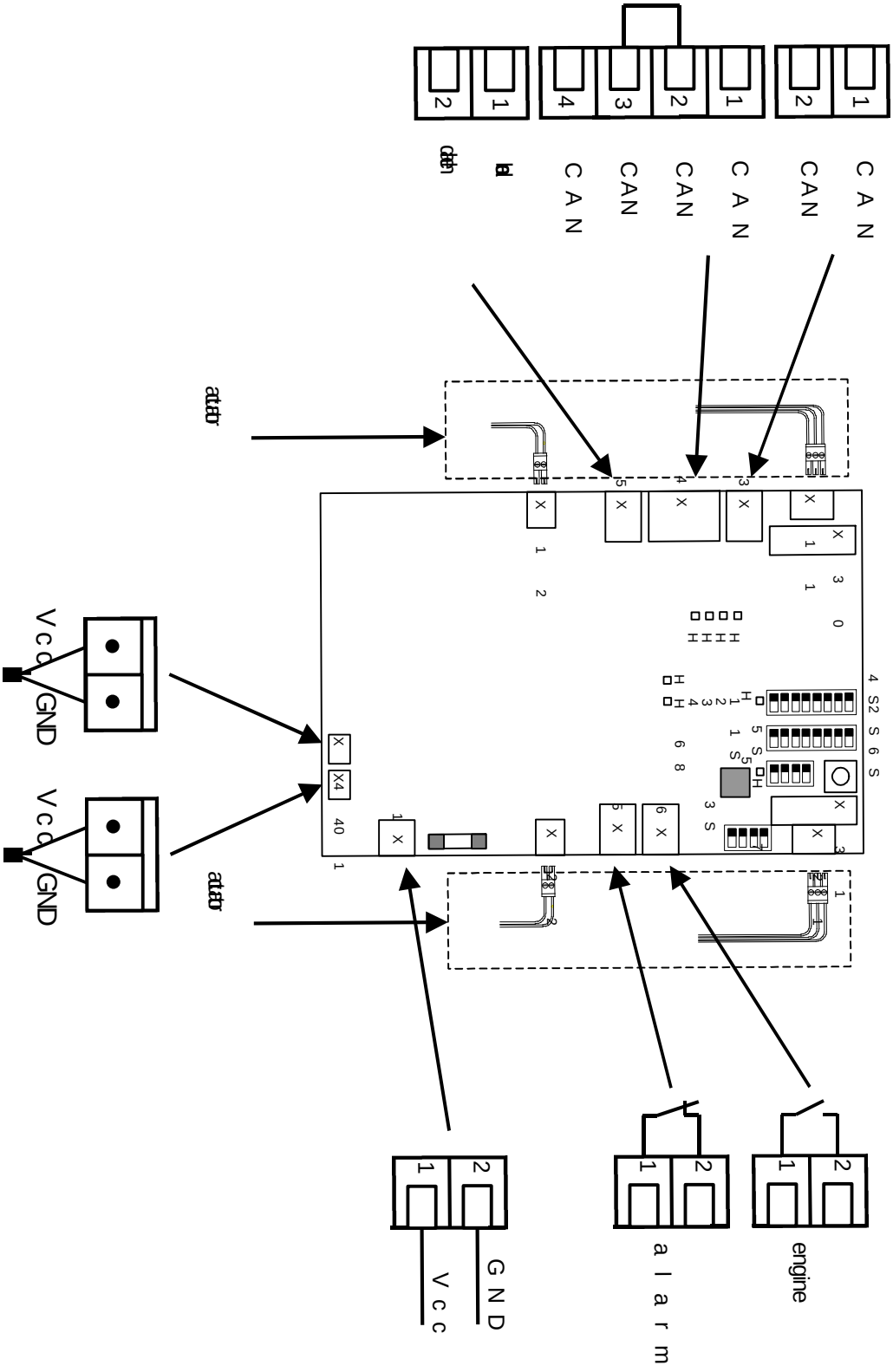
1 ☐ 2 ■ 3 ☐ 4 ☐	**Error type:** GEAR MASTER
	Error description: Gear feedback has been set at the I/O-extension board (see chapter 3.4). The gear feedback is not signalled (for twin engines on the port side). The system works without gear feedback.
	Error elimination: Check pressure sensor at the gearing. Control LEDs on I/O-extension board (LED actual ahead or astern or collective feedback). Check wiring.
1 ☐ 2 ☐ 3 ■ 4 ☐	**Error type:** PAS-CTRL
	Error description: The control states a total failure of a passive control head.
	Error elimination: Check wiring (see chapter 3.2). Check LED power supply at the defective passive control head. If necessary replace control head.
1 ☐ 2 ■ 3 ■ 4 ☐	**Error type:** PAS-CTRL-HW
	Error description: The hardware of a passive control head is defective (e. g. potentiometer error).
	Error elimination: Replace defective control head
1 ☐ 2 ☐ 3 ☐ 4 ■	**Error type:** GEAR SLAVE
	Error description: Gear feedback has been set at the I/O-extension board (see chapter 3.4). The gear feedback on the twin engine at the starboard system is not signaled. The control works without gear feedback.
	Error elimination: Check pressure sensor at the gearing. Control LEDs on the I/O extension board (LED actual ahead or astern or collective feedback). Check wiring.

1 □ 2 ■ 3 □ 4 ■	**Error type:** CTRL-POS
	Error description: Before adjusting parameters for speed and gear control, the active control head must be placed in the correct position (see chapter 4.3 or 4.4). It is not permitted to adjust the parameter in this lever position.
	Error elimination: Change to RUN-mode (step 1 in chapter 4.3 or 4.4). Move lever in correct position then and repeat the adjustment.
1 □ 2 ■ 3 ■ 4 ■	**Error type:** PROCEDURE
	Error description: Parameters were set (chapter 4) in incorrect order (e. g. adjustment of rotary switch PARSEL in SETUP-mode).
	Error elimination: Change to RUN-mode (step 1 in chapter 4.3 or 4.4). Move lever in correct position then and repeat the adjustment.
1 □ 2 □ 3 ■ 4 ■	**Error type:** ADJUST
	Error description: It has been tried to set a parameter (chapter 4) that does not exist at all according to the system configuration (chapter 2) (e. g. rpm starboard for a single engine system). Or, the rotary switch PARASEL was turned to a value which was not admissible.
	Error elimination: Correct setting of switches and rotary switch PARSEL.

Control Unit – In- and Outputs



Control Unit - Terminals



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